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IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

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THE CHEMICAL NEWS.

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CHEMISTRY OF THE COMET.

PROBABLY few of our readers are ignorant that a most brilliant member of this erratic celestial family is now a conspicuous object in the northern heavens. It first made its appearance on Sunday evening last, after sunset, when, as the clouds cleared away, it was suddenly discovered shining as bright as a star of the first magnitude, and almost rivalling the magnificent comet of 1858 in brilliancy and development of tail, whilst it far surpassed it in the diameter of nucleus.

An opportunity which perhaps may never occur again is thus allowed for physicists to become acquainted with the intimate constitution of these mysterious visitors. On the occasion of the last appearance of so brilliant an object, in 1858, philosophers could do little more than examine it through their telescopes, and wonder, and speculate on its constitution. Since then, however, science has made rapid strides, and we are at the present time in possession of methods of analysis vastly more searching and powerful than any known previously. Chemists can now analyse, in the most rapid and accurate manner, almost everything which is visible to the human eye. It matters not whether the body possesses a tangible substance or not, whether it is close at hand in a test-tube or millions of miles away; if it only fulfils the one condition of emitting light, it is almost certain to reveal the secrets of its composition when submitted to the new development of *spectrum analysis*.

The actual metallic constitution of the sun has already been shown by this means; that of the fixed stars is likewise being ascertained in the same manner, and we really hope that the present opportunity will not be allowed to pass without the beautiful method of spectrum analysis being applied to determine the elementary constitution of cometary bodies. The apparatus required would not be more than is already in the hands of many scientific men. A large telescope, equatorially mounted, would, from some experiments of our own upon this subject, seem to be necessary, in order to obtain sufficient light to illuminate the field of view. The spectrum apparatus being placed in proper adjustment, the luminous image only requires to fall on the slit and along the axis of the collimating tube for the fixed lines in the cometic spectrum to be instantly visible. A small and temporary arrangement, hurriedly fitted up, has been sufficient to satisfy us of the existence of fixed lines in the spectrum of the light emitted from the comet at present visible, but they were too faint to admit of identification. This experiment should at once be repeated with larger and more powerful apparatus. Many important questions would thus be finally settled. If the comet shone merely by reflected light from the sun, the ordinary solar fixed lines would be the only ones visible. If, however, as is most probable, some of its splendour is due to native light, the spectrum would as readily reveal whether the nucleus or the tail were in the solid or vaporous state; if the former, it would give a continuous spectrum, whilst if it were a vapour, the spectrum would be disconnected, and the new lines in it would at once disclose the elementary bodies to which they were due. It is, however, impossible to foresee all the valuable information on the obscure subject of stellar chemistry which could in this manner be obtained. We trust that, having pointed out this most promising field of observation, the rich harvest of facts with which science can thereby be enriched will not be allowed to escape for want of able observers.

WATER *versus* FIRE.

THE natural antagonism of fire and water is so deeply rooted a matter of popular belief that were it not for the striking illustration to the contrary exhibited by the recent gigantic conflagration near London-bridge, we should scarcely venture to raise a doubt on this point. A visit which we paid to the burning ruins soon after the outbreak, and some observations which we made on that occasion while accompanying the firemen as near as could be ventured to the blazing mass, have, however, served to confirm our previous impressions in a remarkable manner.

The action of water in quenching fire is principally due to two causes. One is its great capacity for heat, a property which enables it to exercise a considerable cooling influence upon any burning body. The other is its fluidity, enabling it to run over the surface and penetrate the pores of a combustible body, acting the part of a varnish, sealing it up from contact with the atmospheric oxygen, and thereby stopping combustion. In the case of water supplied from a fire engine, the mechanical force with which it impinges upon the burning body may likewise have some beneficial effect, actually beating out the fire as if with a stick. It will however be seen, that unless the volume of water thrown on to a fire be very large indeed in proportion to the bulk of that fire it can do but little good; and if it be very small in comparison to the amount of burning material, it is positively injurious, acting the part of additional fuel to the flames.

Every chemist knows what takes place if a small quantity of water is projected into the midst of a large mass of red hot combustible matter. It is decomposed in presence of the carbon into carbonic oxide and hydrogen, each highly combustible gases, and thereby tending to increase the volume of flame. This we are satisfied was the case with a large proportion of the water which was thrown on during the first few days of this memorable fire. Standing inside the gates of Cotton's Wharf we watched a jet of water from the powerful steam fire-engine, as the firemen directed it into a brightly burning mass of combustible matter. The liquid hissed and vaporised the instant it touched the incandescent matter on which it was directed; but in this and in most other instances where water was

directed into the fiercest parts of the fire, the supply of heat from combustion was so much in excess of the loss of heat required to vaporise the water, that, except at the spot on which the solid jet of liquid fell, there was scarcely any appearance of deadening or quenching, and as soon as the hose was directed towards another part of the blazing mass, the spot on which the water had been previously falling glowed as brightly as ever.

The supply of water, however, had not only a negative action, in some cases it did positive injury; for after falling into the brightly glowing fuel and becoming at once vaporised, it rose through the thick masses of red hot combustible matter, and there underwent decomposition. To a careful observer the result could be seen in the form of an increased vigour in the tongues of flame, which rose and licked the neighbouring walls with renewed violence. We were curious to see if this decomposition and subsequent recombustion of the water could be rendered visible, and on a subsequent occasion examined the flames by means of a small pocket spectroscope. A portion of the ruins was chosen which still blazed with almost its original fierceness, and on which a stream or two of water was being pumped. The spectroscope was at first turned towards a portion of the flames where there was no water; as might be expected the spectrum was quite continuous; a faint glimmer only of the yellow soda line being occasionally visible; but upon the men directing their hose upon this portion, the yellow line instantly shot across the field of view with great splendour, and remained there during the whole time the water was being poured into the burning mass. We subsequently found that the presence of this line offered an easy means of telling whether water was being poured into any portions of the burning ruins. Where water was absent the line was only occasionally visible, whilst whenever water was added to the flames it appeared with considerable brightness, projected across the continuous spectrum.

Now, we submit that this is a good (though indirect) proof that the water had suffered decomposition, and that some portion of the flames which were towering towards the sky consisted of the burning elements of this identical water, which thus acted the part of fuel to the fire. The great difficulty of preparing "water gas," even in the laboratory, so as not to burn with a yellow flame, is well known, and it is therefore unlikely that when formed under circumstances eminently suitable for the production of the yellow soda flame, this should not be present in considerable quantity.

Another point that struck us most forcibly when watching the firemen with their hose, was the utter absurdity of the attempt to produce any effect upon so stupendous a conflagration with such an insignificant jet of water. Three acres of combustible matter were blazing and roaring like a blast furnace, and just at the outskirts of the burning heap a few thin streams of water were being sprinkled on, producing about as beneficial an effect as if a child had taken a penny squirt to it, not even wetting it so much as a heavy shower of rain would have done. It is scarcely part of our province to suggest an improvement on this state of things. To place a floating fire-engine on the Thames capable of raising any number of tons of water per minute, and deluging an incipient fire in so perfect a manner that further outbreak would be impossible, seems a not very difficult problem, although it is one for mechanicians rather than chemists. Like all other difficulties now-a-days, the only question requiring answer is, "How much will it cost?" and whatever that might be, it could not possibly come up to what the Insurance Offices will have to pay for this one fire.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Colour-tests for Strychnia and the Diagnosis of the Alkaloids, by William A. Guy, *M.B. Cantab., Fellow of the College, and Professor of Forensic Medicine, King's College, London.*

(Continued from vol. iii. p. 303.)

I now proceed to discuss the third of the four questions propounded in my first communication, namely, Are the colour-tests, or is the selected test, open to any serious objection?

Of chemical tests in general, it may be said that they are more or less liable to the following objections or disparagements:—1. They may be wanting in delicacy; that is to say, they may not be able to detect minute quantities of the substances to which they are applied as tests. 2. They may be wanting in certainty; in other words, they may fail from slight causes difficult to appreciate and define, such as the quantity or proportion in which they are applied, or the strength of their solutions if used in the form of liquid. 3. They may give rise to transient effects, or to appearances difficult to describe or define. 4. They may be unusually liable to failure from impurities in themselves, or in the matters to which they are applied as tests. And, lastly, they may produce of themselves appearances nearly allied to those which they occasion when added to the matters under examination.

From the first of these objections all the colour-tests for strychnia are certainly free. They are able to detect very minute quantities of the poison. From the fourth objection, too, as it will presently be shown, they are at least as free as the majority of chemical tests. To the second, third, and last objections they are certainly exposed, but under what circumstances and in what degree, it will be necessary to inquire.

The occasional failure of the colour-tests for strychnia from slight and obscure causes is not to be denied. It is proved by the experiments already detailed, and is admitted by all experienced chemists. But it should be understood that this objection has only a limited application. It goes only to the extent of impairing the value of the evidence derived from a negative result. If the colour-tests fail when applied to a spot acted on by sulphuric acid, their failure is not conclusive evidence of the absence of the poison. It affords a strong probability of such absence, but nothing more.

The reactions of the colour-tests for strychnia are certainly transient. They are not like the permanent white, crystalline, or coloured precipitates afforded by most chemical tests. But the objection on this ground is also of limited application. In experiments with the colour-tests made in the manner described in a former communication, we obtain two classes of results. We may get a mere trace or "flash" of blue, or we may obtain a deep rich blue colour, lasting for several seconds, for half-a-minute, or even for forty-five seconds, and succeeded by the other tints already described. Now those who maintain the value of the colour-tests for

[1] Substance of part of the Croonian Lectures for 1861, delivered at the Royal College of Physicians; from the *Pharmaceutical Journal.*

strychnia do not pretend that a mere flash of colour affords such evidence of the presence of strychnia as could be used with safety in a court of law; but they would probably be found to assert with equal confidence that a deep rich blue colour, developed by the colour-producing tests for strychnia, and continuing for several seconds in a spot previously treated with sulphuric acid without change of colour, and then succeeded by other colours, affords good evidence of the presence of strychnia. Though the blue colour soon passes away, there is ample time afforded for its complete recognition.

In answer to the objection that the succession of colours is difficult to describe or define, it will suffice to state that though it may not be possible by any words that we can use to describe the successive colours developed by the colour-tests, it is not necessary to do so. For the first deep rich blue colour, characterised by the property of want of permanence, is in itself so remarkable as to constitute a most valuable and trustworthy test for strychnia.

The colour-tests for strychnia are certainly open to the objection that the colour-developing substances are themselves coloured. The peroxide of lead is puce coloured, the peroxide of manganese black, the bichromate of potash orange coloured, the ferricyanide of potassium yellow or orange, and the permanganate of potash lilac. The peroxide of lead and the peroxide of manganese also colour sulphuric acid by admixture, and the bichromate of potash, ferricyanide of potassium, and permanganate of potash change the colour of the acid by solution. But it has been shown that the colours thus produced cannot possibly be confounded with the strychnia blue, and consequently form no valid ground of objection.

The fourth of the five objections applicable to chemical tests in general, certainly does not apply with any force to the colour-tests for strychnia; for I can state as the result of experiments with a great variety of substances, vegetable and animal, including all the matters that are likely to remain mixed with strychnia after its extraction from the contents of the stomach, or from the fluids and tissues of the body, and further with many mineral substances, including common salt, arsenious acid, tartar emetic, and corrosive sublimate—all these animal, vegetable, and mineral substances having been added in quantities far exceeding those in which they could possibly exist as impurities in strychnia extracted from the contents of the stomach, or from the fluids and tissues of the body,—that the colour-tests are little, if at all, affected by such admixtures. This observation applies to the permanganate of potash equally with the bichromate of potash.

For practical purposes, the reaction which demonstrates the presence of strychnia may be described as a clear, rich blue colour, developed by the colour-tests in a spot previously treated by strong sulphuric acid without change of colour, the blue colour in question lasting long enough for perfect recognition, and then passing into other colours. In the absence of the blue colour we can affirm the probable absence of strychnia, but a mere flash of colour does not afford a degree of evidence upon which we ought to rely in a medico-legal inquiry.

Assuming the description just given to be correct, I now proceed to inquire whether there are any known substances which give rise to a similar reaction. The answer must be, in a qualified sense, in the affirmative; but it must be understood the reaction is only *similar*, not the *same*.

Such a substance is to be found in cod-liver oil, which, when treated with strong sulphuric acid, assumes a purple tint, mixed with streaks of blue, changing after a time to mulberry, and from that to a red-brown. In these changes of colour there is such a general resemblance to the strychnia tints as would justify their being put forward as an objection to the colour-tests, but for the very obvious consideration that with sulphuric acid alone strychnia undergoes no change of colour. The very fact, too, that cod-liver oil is an oil, while strychnia is tested either as an alkaloid or the salt of an alkaloid, as a crystal or as a white powder, or as a dry deposit from a liquid holding it in solution, deprives this objection to the colour-tests for strychnia of all practical value.

Again, aniline is mentioned as a source of fallacy. But aniline is a coloured liquid, which yields with sulphuric acid a dense white precipitate, the sulphate of aniline. Strychnia, on the other hand, is a crystal or white powder, or a dry deposit from a liquid holding it in solution.

But the sulphate of aniline, which is formed by adding the strong sulphuric acid to the liquid aniline, is sold as a white powder, as are some specimens of strychnia. Hence the sulphate of aniline might possibly prove a source of fallacy, inasmuch as it gives no change of colour with sulphuric acid, and yet when treated with the colour-producing substances yields a colour similar to the blue of strychnia. But the sulphate of aniline, in place of a rich, deep blue, passing speedily into mulberry, and at length into bright red, assumes at first a pale green, which deepens by slow degrees, then passes into a beautiful blue, continuing unchanged for a long period, but at length turning to a black. So that the first characteristic colour with strychnia is the second with aniline, and the transient colour with strychnia is persistent with aniline.

Again, there is a red crystalline substance, pyroxanthine, which produces with sulphuric acid alone, without addition of the colour-producing tests, a blue similar to that produced by strychnia. But there is here no real fallacy, because strychnia is not coloured, and does not yield any colour with sulphuric acid alone.

Nor do papaverine and narceine, which are tinged purple by sulphuric acid alone, create any difficulty, or occasion any fallacy. And the same may be said of the whole body of alkaloids and active principles, whether coloured or colourless, which yield colours when treated with sulphuric acid alone. Of those which resemble strychnia in giving no colour with sulphuric acid, it may be stated with equal confidence that not one of them yields with the colour-developing substances the true strychnia colours, or any colours resembling them.

The foregoing are given as examples of the sort of objections that are urged against the colour-tests for strychnia. They belong to the class of objections which no one out of a court of law would bring forward as worthy of serious attention. They are based, not so much on a misapprehension of the facts, as on an illogical comparison of dissimilar phenomena. But there is one objection founded on a misapprehension and quite unintentional misrepresentation, which ought not to be passed over in silence. It is stated by Dr. Taylor, in his work on Poisons, that the alkaloid curarina obtained from the South American poison curara, "resembles strychnia in the action of the colour-tests, brucia in the action of nitric acid, and both in its intense bitterness." These are the words used by Dr. Taylor at p. 786 of the second edition of his work; and on referring to p. 772, he says of the same alkaloid, that "strong nitric acid

produces with it a blood-red colour; sulphuric acid gives with it a rich carmine tint, in which characters it resembles brucia," and, further, that Pelikan found pure curarina to possess the chemical properties of strychnia, so far as the colour-tests are concerned, and with more constant results. Thus, sulphuric acid when conjoined with the action of chromate of potash, ferricyanide of potassium, or peroxide of lead, "produced a beautiful play of colours," and "that the galvanic test acted similarly." Now, on referring to the passage cited from Pelikan, I find that this beautiful play of colours is a translation of the words, "des colorations rouges très belles," and "la coloration rouge," the one expression being applied to the chemical tests, the other to the galvanic test. So that the alkaloid curarina is set up as a fallacy on the strength of its yielding with the colour-tests (sulphuric acid mixed with chromate of potash, ferricyanide of potassium, or peroxide of lead) a brilliant red colour, or colours, instead of the beautiful play of colours, blue, mulberry, and red, which jointly, and not separately, characterise strychnia. If any one colour is to be deemed the strychnia colour *par excellence*, it is the rich deep blue, and not the brilliant red. Let it also be remembered that sulphuric acid gives with curarina, according to Bernard, a rich carmine tint, while strychnia undergoes no change of colour when treated with sulphuric acid. The statement made by Dr. Taylor that in giving a blood-red colour with strong nitric acid and a rich carmine tint with sulphuric acid, curarina resembles brucia, is evidently founded in error. The reaction of brucia with nitric acid is correctly stated, but brucia certainly does not yield a carmine tint with sulphuric acid. It is one of the list of substances grouped together in my tables as characterised by a negative action with sulphuric acid; and Mr. Jenkins, in the table which I sent round in my last lecture, attributes to it a negative reaction with sulphuric acid (see CHEMICAL NEWS, October 6, 1860); and here I may observe that it is one of the obvious advantages of tables such as these that they place before us the common and familiar reactions of the substances which they comprise, in such an orderly and methodical way as greatly to assist the memory, and to guard against such inadvertent statements as this of Dr. Taylor's respecting brucia.[2]

On referring to the tests for brucia itself, as given at page 801 of Dr. Taylor's work on Poisons, from which I have been quoting, I find it stated that "strong sulphuric acid colours brucia of a rich rose-pink colour." This colour differs widely from the rich carmine (*belle teinte carminée*) of Bernard, said by Dr. Taylor to be characteristic of the same reaction, and I think that I may venture to state of it that it is not the reaction of pure brucia with pure sulphuric acid. Indeed, it is not the reaction of specimens of brucia of ordinary purity with specimens of sulphuric acid of similar purity. To obtain a rich rose-pink with brucia, we must use a specimen of sulphuric acid containing an unusual quantity of nitric acid, and I have no doubt that the unintentional use of such an acid gave rise to this misapprehension. I may add, that to specimens of brucia of fair average quality sulphuric acid will impart a very slight tint (rose colour or buff), and a still slighter tint to the solution of the alkaloid in the acid. But a rich rose-pink colour is an evidence of the presence of nitric acid, and is readily developed in the solution of the alkaloid in sulphuric acid by a short exposure to the vapour of nitric acid.

I could not have accomplished the object I have in view of vindicating the colour-tests for strychnia from unfounded objections, without tracing this particular objection to its true source. It was necessary to show that the reactions of the rare alkaloid curarina, differ essentially from those of strychnia, and of brucia, which is associated with strychnine in more than one of the plants that yield it; and I could not do this without showing that an esteemed medico-legal authority had made a mistake in reference to a reaction, and an oversight in rendering the words of a French author.

I may add, that on comparing the extract of nux vomica with a specimen of curara poison, for which I am indebted to the kindness of Mr. Morson, and with the brown powder scraped from an arrow tipped with the same poison, and forming one of a collection kindly presented to me by Mr. Stone, of the College of Surgeons, I find no resemblance between the one extract and the other, except in the property of intense bitterness. The woorara poison imparts to strong sulphuric acid a greenish-brown tint, and the nux vomica a pink colour; while strong nitric acid, which turns the first to a pale, dirty yellow, changes the second to a very distinct orange colour. The addition to the solution in sulphuric acid of bichromate of potash produces less effect on the colour of the curara than takes place with the extract of nux vomica. If the woorara really contained any alkaloid capable of developing with sulphuric and nitric acids the deep rich colours attributed to it, I think that some approach to those colours might be expected in the extract itself.

I may conclude this part of my subject by expressing my firm conviction that to the colour-tests applied in the manner I have recommended, there is no valid logical objection; and that though a negative result is not conclusive of the absence of strychnia, a positive result (by which I must be understood to mean the development of a rich blue colour on stirring the colour-developing substances into a spot first treated with sulphuric acid without change of colour, the rich blue colour in question passing, after a few seconds, into other colours) affords undeniable proof of its presence.

In my next and last communication I shall endeavour to discriminate the principal alkaloids from each other, and to represent the differences between them by convenient tabular forms.

(To be continued.)

[2] These tables will be referred to more particularly in my next paper.

On the Oleaginous Matter formed on Dissolving different kinds of Iron in Dilute Acids, by EMERSON J. REYNOLDS.

PROUST, I believe, was the first chemist who noticed that the hydrogen prepared by dissolving black cast iron in dilute sulphuric acids possessed a most offensive odour, and that on being passed through glass tubes it caused them to assume a greasy appearance, apparently due to the deposition of an oily matter, which he appears to have considered as a combination of hydrogen and iron, the non-production of which body under the circumstances I will demonstrate further on.

Berzelius afterwards noticed the formation of this oleaginous body, and gave it as his opinion that it was a compound of carbon and hydrogen. More recently, Professor Cameron (in 1855) made some experiments on this oil, the results of which he communicated to the

Chemical Society of Dublin. He found it to be very volatile, and destitute of nitrogen, and also that certain metallic salts removed the offensive odour produced by ts presence.

But, after all, two very important points have been left undetermined, namely, the precise conditions under which this body is formed, and its chemical and physical characters and relations.

Now, it is the first of these propositions that I intend dealing with in the present paper, reserving the second for a future communication. I had contemplated waiting until my investigations were completed before publishing the results; but in consequence of some observations made by M. Chevreul, before the Academy of Sciences of Paris, I thought it better to bring forward what I have determined up to the present time. Chevreul stated that the combination of the iron with the hydrogen seemed difficult to admit, and that this consideration had led him to conjecture that the water might assist in the production of the oily matter. He, moreover, considered that the researches of M. Fremy[1] on cast iron and steel, seemed to throw some light on the subject, by indicating that it is not carbon, as was represented, which yields the oily body. Now, we can clearly gather from this that M. Chevreul points to nitrogen as being, possibly, the principal constituent of the oil, and not carbon.

In order to clear away all doubts as to its origin, it was essentially necessary to answer the three following propositions:—

1. Is the oleaginous body produced during the solution of *pure* iron in dilute acids?

2. Does iron, free from every other impurity but carbon, yield the oil when treated with acids?

3. Will iron, containing nothing but nitrogen, furnish the oily matter on similar treatment?

It will be seen at a glance, that the careful solution of these propositions would be certain to make us acquainted with the circumstances which influence its production.

The following are the methods which I adopted for answering each question:—

1. My first object was to prepare absolutely pure iron. This I procured by the process generally employed for preparing "*fer reduit*," care being taken to preclude any possible chance of impurity. The peroxide being precipitated from the pure perchloride by ammonia, after being well washed, it was then submitted to a low red heat. Moreover, the hydrogen gas used to decompose the peroxide was evolved from distilled zinc and pure sulphuric acid. The metallic iron so procured, when dissolved in dilute acid, did not yield the slightest trace of the oil. I did not come to this conclusion after one or two experiments alone, but after repeated trials. This overthrows at once the supposition that the iron combines directly with the nascent hydrogen forming the oil, and, indeed, does more, for its non-formation tends to confirm, if such were necessary, the opinion of Dr. Cameron formerly expressed in this Journal, that such a compound as ferruretted hydrogen does not exist.

2. In answering the second question, it was essential to obtain iron containing some carbon in combination; this I prepared as follows:—Carburetted hydrogen in a pure state was passed over the iron of Experiment 1, heated to redness; the action was allowed to go on for half-an-hour. In this way I obtained iron containing carbon—in fact, cast iron. This compound, when dissolved in acids, gave the oil in such quantity as to allow of its being identified with the greatest ease. This experiment proves with certainty that carbon is essential to the existence of the oil, though, of course, it does not furnish us with any information as to whether the elements of water enter into its constitution or not. This can only be found by its ultimate analysis.

3. The third point to be considered in connection with this subject is, whether or not nitrogen gives rise to any oil. To determine this, another portion of the iron of Experiment 1 was submitted to the action of dry ammoniacal gas for nearly two hours and a-half, by which means it became highly nitrogenised (as was proved by the abundant evolution of ammonia on heating in an atmosphere of hydrogen). This body, when treated with dilute sulphuric acid, which readily attacks it, does not, when so acted on, give the least trace of oleaginous matter. Of this I have satisfied myself; but, instead, a solution of ammoniacal sulphate is produced.

To sum up, then, my experiments show the following:—

1. Pure iron does not yield the oil.

2. Iron containing carbon does give the oil.

3. Iron containing nitrogen does not furnish the oleaginous matter.

So far for the origin of this curious body: it now remains for me to determine by analysis its composition, &c On this subject I am actively engaged at present, and hope to turn to some account the experimental results which I have arrived at in this paper, so as to furnish me with a means of preparing this oil in larger quantity than I have heretofore obtained it.

See Chemical News, vol. iii. p. 332.

TECHNICAL CHEMISTRY.

On Electro-Chemical Colouring and the Deposition of Peroxide of Iron on Plates of Steel and Iron, by M. Becquerel.

Priestly was the first to obtain coloured rings by means of electricity,[1] by receiving strong charges from a battery, with surface of about two square metres, on metal plates, by means of metallic points directed perpendicularly to their surface.

Nobili, in 1827,[2] afterwards produced coloured rings on platinum, gold, silver, and brass plates, by putting them in communication with one of the two poles of a voltaic pile, plunging them into metallic and non-metallic solutions, and then by directing perpendicularly to their surface a platinum point connected with the other pole. With positive silver, for instance, and solution of sea salt he obtained a series of concentric circles surrounded with varied irises, the tints being slightly dimmed by contact with the air. On heating the plates all the rings took a red tint.

I began to study the electro-chemical colouration of metals in 1843,[3] my chief object being, not to produce coloured rings, but to deposit on plates of gold, platinum, copper, and silver, thin and uniform layers of peroxide of lead presenting successively, according to the duration of the operation, which was generally very short, the rich colours of the spectrum. The operation consists in plunging into an alkaline solution of protoxide of lead

[1] *Philosophical Transactions*, vol. lviii.

[2] *Annales de Physique et de Chimie*, vol. xxxiv., second series.

[3] *Comptes-Rendus*, vol. xviii.

*

the piece to be coloured, put in connection with the positive pole of a voltaic pile charged with nitric acid and composed of many layers of plates, and closing the circle with a platinum wire in communication with the negative pole, and of which but the point, which alone touches the alkaline solution, is continually in motion. In contact with the object to be coloured, the protoxide of lead, which forms the positive electrode, super-oxidises, becomes insoluble in the alkali, and deposits itself on the surface in slight adherent layers, producing the colour of the thin plates. Air and light gradually fade these colours—a disadvantage I have already mentioned, and which may in great measure be avoided by covering the coloured surface with alcohol varnish, which acts but very slightly on the peroxide. With a little practice all the tints desired may be given to a large object with hollows and projections, and each part painted with the appropriate colour. These colours are now made fast by the processes to be described further on.

If the solution of protoxide of lead in potash is replaced by a solution of protoxide of iron in ammonia, and the gold, copper, or platinum plate by one of polished iron, there is deposited on the latter a layer of peroxide of iron with red or brown tints, which deepen more and more according to the thickness of this stratum, which never exceeds a certain limit on account of the imperfect conductibility of the peroxide.

In a paper on the precipitation of metals from their solutions by other more oxidisable metals,[4] I stated that on plunging a copper plate into a solution of double chloride of potassium and platinum, heated to 60°, the platinum is deposited and adheres to the copper, producing a platinization, which is quickly acted on by the air, taking first a slightly brownish tint, which becomes darker and darker.

This alteration is partly due to the presence of protochloride of copper, which is deposited simultaneously with the platinum towards the end of the operation. The protochloride may be removed by washing the platinised copper with water and acetic acid, or by rubbing its surface with cotton and rouge. The alteration is then avoided, or at least does not appear till long afterwards, probably on account of the air traversing the interstices of the platinum, which with copper forms a voltaic pair. The brownish colour of the platinum surface is like that which protochloride of copper ordinarily takes under exposure to air and light.

If we make use of platinised copper directly it is obtained from a solution of double chloride as a positive electrode to decompose water with a pile composed of several elements, it produces, under the influence of the oxygen disengaged from the positive pole, peculiar colouring effects, seeing that the tints pass immediately to blue and deep crimson, and the protochloride of copper is not modified by light. While in contact with platinum the latter metal doubtless contributes to the colouration. No similar result is obtained by operating with platinised plates previously treated with acidulated water or rouge. Furthermore, air has no effect on the colours produced—not an unimportant fact, as it will make it possible to obtain fast colours also with peroxide of lead.

Owing to the strata of oxide, the result is the same if heat is gradually applied to non-preserved platinised pieces, but the colours are less brilliant.

If a copper plate with a layer of peroxide of lead giving one of the beautiful colours of the spectrum is employed as a positive electrode to decompose the water, in a few moments it will be found that the coloration is preserved—a result similar to that obtained with platinised copper. By continuing the electro-chemical action for a quarter or half-an-hour, according to the force of the pile, the blue-violet tints fade, turning to green and yellow, as peroxide of lead. The basis of the coloration undergoes no change at the positive pole. It is thought that the acid secondary products formed at the positive pole react on the peroxide and decompose it.

The coloured plates thus preserved seem to be in the same condition as iron when it has been plunged in nitric acid, or when it has been used as a positive electrode to decompose this same acid. It is then in an abnormal state, being unattackable by nitric acid.

When a very slight layer of platinum is electro-chemically deposited on a gold or platinum plate by means of a solution of double chloride of potassium and platinum containing no copper, this layer undergoes no change either by the action of the air or when the plate is employed as a positive electrode to decompose water; but it is otherwise when the solution contains copper. The colouring effects before described are then produced, when the proportion of copper is small and the coloration of the platinum is not destroyed by weak nitric acid—an important advantage practically. In this memoir we have indicated a great improvement in the process of coloration, for by its means more uniform and adherent layers of metals are deposited.

Magnificent colouring effects are produced by a solution of double chloride of potassium and platinum in hyposulphite of soda.

Lastly, deposits of peroxide of iron on iron and steel, which are already almost unalterable by air, will become entirely so when the pieces have been employed as positive electrodes to decompose water.—*Comptes-Rendus.*

[4] *Comptes-Rendus*, vol. xviii.

PHARMACY, TOXICOLOGY, &c.

Plasmata or Glycerine Ointments.

The use of a simple plasma or glycerine ointment in eczema and other skin diseases has been common for some years, both in Germany and England. Of late, however, Graefe, of Berlin, has employed it as a vehicle for the application of various active remedies in diseases of the eye.

Simple plasma is made by heating one part of starch with seven parts of glycerine. The heat of a water-bath is not quite sufficient to effect the solution of the starch; and great care must be taken in regulating the heat and continually stirring the mixture to prevent burning. When atropia or belladonna are to be combined with this simple plasma, it will be very important to avoid the burning, which, besides giving a disagreeable appearance and smell, will in these cases seriously affect the remedial value of the compound.

The advantages which this compound possesses over lard, or mixtures of oil and wax, as a vehicle for active remedies, are, that it is soluble in water, retains its consistence at all ordinary temperatures, and, lastly, does not become rancid. It does, however, after a time (usually several months), become mouldy on the surface, but this can be easily removed, leaving the remainder quite good.

With this simple glycerine ointment various substances are now combined, such as atropia, extract of belladonna, extract of opium, sulphate of copper, acetate

of lead, the ammonio-chloride, nitric oxide, and subnitrate of mercury and nitrate of silver. The last is said to be used in Germany, but appears to us a most ineligible compound, for the nitrate commences to decompose the moment it is brought in contact with the starch, and in a very short time is completely reduced.

The plan adopted in the preparation of these ointments may be varied, according as the active agent to be introduced is soluble in glycerine or not. In the former case, as with the extracts before mentioned, atropia and sulphate of copper, they should first be dissolved in the glycerine, and the solutions of the extracts, if necessary, strained; the starch should then be mixed with the solution in a mortar, and the mixture transferred to an evaporating dish to be heated. If the active agents are insoluble in glycerine (as the mercurial salts), they should first be thoroughly mixed with the starch before the glycerine is added. In each case it is advisable to stir the mixture industriously while the heat is applied, as well to ensure the proper distribution of the ingredients as to prevent the burning.

We now proceed to give the formulæ for the compounds which are in use and about to be introduced into the Pharmacopœia of the Royal London Ophthalmic Hospital. It must be premised that the solubility of the menstruum permits the use of a smaller quantity of the active ingredient, and it will be seen that when there is a corresponding ointment in the London Pharmacopœia, the plasma has half the amount of the active ingredient.

Plasma with Sulphate of Copper.

℞	Cupri sulphatis . .	gr. xxiv.
	Pulveris amyli . .	ʒjss.
	Glycerinæ . . .	ʒxss.

First dissolve the sulphate of copper in the glycerine, then mix the starch, and heat until the plasma acquires a proper consistence. The sulphate of copper being soluble in the glycerine, this forms a very elegant preparation, of a delicate, transparent, greenish-blue colour.

Plasma with Extract of Belladonna.

℞	Extracti belladonnæ . .	gr. xlv.
	Pulveris amyli . . .	ʒjss.
	Glycerinæ	ʒxss.

First dissolve the extract of belladonna in the glycerine, and, if necessary, strain; then mix the starch with the solution and heat carefully, stirring continually until the plasma acquires a proper consistence.

Plasma with Ammonio-chloride of Mercury.

℞	Hydrargyri ammonio-chloridi .	ʒss
	Pulveris amyli . . .	ʒjss
	Glycerinæ	ʒxss

Plasma with Nitric Oxide of Mercury.

℞	Hydrargyri nitrico-oxidi .	gr. xiv.
	Pulveris amyli . . .	ʒjss
	Glycerinæ	ʒxss

Plasma with Subnitrate of Mercury.

℞	Hydrargyri subnitratis .	gr. xl.
	Pulveris amyli . . .	ʒjss
	Glycerinæ	ʒxss

These three preparations may all be made in the same way. The mercurial salt should first be intimately mixed with the starch and then the glycerine added. It is, of course, important in each case to stir well while the heat is applied. The plasma with the subnitrate is intended to be used in place of the unguentum hydrargyri nitratis,—a preparation to which it does not, however, fully correspond. But there are objections to boiling an acid solution of mercury with glycerine, and if the cold acid solution be mixed with the plasma it soon becomes almost liquid. The liquid preparation, however, might be useful under some circumstances. The preparation is intended to represent an ointment half the strength of the unguentum hydrargyri nitratis of the London Pharmacopœia.

Plasmata with extract of opium and atropia and acetate of lead may also be easily made. Extract of opium dissolves in glycerine, and this plasma may be prepared in the same way as that with extract of belladonna. When atropia is used great care must be taken in heating the mixture, as the atropia is destroyed at a temperature a little above that of boiling water. Two grains of atropia to one drachm of the plasma is a convenient strength for dilating the pupil of the eye.

PHYSICAL SCIENCE.

On the Nature of the Spark of Ruhmkorff's Induction Apparatus,[1] *by M.* Adolphe Perrot.

1. The induction spark, which explodes between the extremities of the induction wire in Ruhmkorff's apparatus, when the inductor current is interrupted, possesses at the same time the property of tension, more especially characteristic of the static state, and the properties of quantity characterising the dynamic state.

2. This spark may be divided into two parts, one possessing only the qualities of tension, the other those distinguishing the dynamic state.

PROCEEDINGS OF SOCIETIES.

THE SOUTH KENSINGTON MUSEUM.

Monday, January 7, 1861.

On the Importance of the Study of Chemistry, by A. W. Hofmann, *LL.D., F.R.S.*

In compliance with an invitation from the Committee of Council on Education, I will endeavour to bring under your notice some considerations on the Study of Chemistry as part in a well arranged system of mental cultivation. In an attempt of this kind, owing to the endless variety of relations which chemistry bears to other branches of knowledge, so many starting points present themselves, that it seems important to define at the very outset the aspects under which I propose to submit the subject to your attention. I may, therefore, state at once that I shall examine the question more especially in two directions, aiming, in this first Lecture, at giving you a survey of the conditions which render the study of chemistry invaluable as advancing the material well-being and the intellectual progress of mankind, and pointing out in a second Lecture, the path recognised by experience as the shortest and safest towards the perfect mastery of chemistry as a science; adding at the same time, some remarks on the chemical instruction in schools, where chemistry is taught as a branch of general education, and as a means of mental training.

The importance of the study of the natural sciences, and particularly of chemistry, becomes at once obvious when we compare our modern civilization with that of antiquity. Losing sight of the revolution brought about in the human mind by the reception of new religious views, as not immediately connected with the subject of this discourse, it

[1] Abstract of a paper in the *Annales de Chimie et de Physique*, sect. 3, vol. lxi. pp. 200—222.

cannot be denied that all the other steps of progress which modern times have made, are exclusively derived from the ardent cultivation of the study of nature.

In poetry and sculpture the ancients are still unsurpassed. What epic poem, as to originality, vigour, and freshness, can be compared to those of Homer? We admire the genius of a Shakespeare, the searching eye with which he traces human nature to her innermost recesses; we are carried away by his life-warm creations. Whether he reveal the tenderest emotions of the human breast, or roll before our view the stormy waves of passion, we unhesitatingly accord to him the palm as the first dramatic poet of modern times. Let those, however, who have read the Greek tragedians say, whether Sophocles has been surpassed by Shakespeare!—Modern sculpture ever turns to the antique as to a model of unattained perfection. In all times, from all countries, the sculptor has made his pilgrimage to Rome and Greece to study in the school of the ancients.

He who has seen the frescoes on the walls of Pompeii will bear witness to the high attainments of the painters of those ages, and, granting a great development to the art of painting in modern times, it would be difficult to say how far this is owing to our different mode of viewing the world, which has altogether changed the scope of artistic aspiration, or to the technical improvements, more especially in the colours, which are at present at the disposal of the painter. It is next to impossible to form a clear notion of the music of the ancients; but if we consider the simplicity of the instruments at their command, there can be no doubt that the advance, which modern music has made, is mainly referable to our perfected construction of their instruments, and to the invention of new instruments, for which again we are indebted to an active study of the laws of nature.

Our writers of history, too, in what do they surpass their predecessors except in the endless abundance of material which century after century has heaped up in addition to what they possessed? The writings of the ancient historians are still the first which we place in the hands of our youth, and experience has proved what an inexhaustible source of mental and moral culture successive generations have found in these works. No nation of modern times has produced more brilliant orators than England; as none possesses freer institutions, the native soil of eloquence. But have modern orators outstripped the Greeks and Romans (except, perhaps, in the formidable length of their speeches)? To him who would ascertain what progress the schools of mental philosophy in later times have made, compared with those of antiquity, I recommend a plunge into the works with which a certain school deluged the literature of Germany at the commencement of this century. Again, has not modern jurisprudence its very root in the Roman law? Is not the Roman law taught at this very day in all the continental universities? and is not the civil law of the Romans still in force in many states at the present time? I may be reminded of the enormous strides which the mathematical sciences have made in modern times, but we still learn from Euclid the rudiments of geometry: and are we quite sure that the methods, which, like so much new apparatus, has been supplied to mathematical operations, would have unfolded themselves, had it not been for the wonderful development of the natural sciences, more especially of physics, which continually offered to mathematical treatment new material to be mastered, and thus in a measure involved the creation of these very methods?

I might easily pursue this parallel still farther, but I have already said enough for my purpose.[1] Modern civilization most undoubtedly has its footing in the zealous investigation which the present age has devoted to the forces of nature, and in the wonderful results to which this investigation has led, and, day by day, is leading. The study of the forces of nature has subjected them to our will. Knowledge is power; under no conditions is this axiom truer than when applied to the knowledge of natural phenomena. Time and trouble spent on the study of nature is amply repaid, for in every well examined physical force, man educates for himself an obedient servant, ready at all times to fulfil his behests.

What giant strides in all directions have been made in consequence of the development of the various branches of physical knowledge? The power of steam has gradually become subservient to such a variety of uses that we can scarcely imagine our existence without it; and yet when we see our steamships cleaving the ocean from hemisphere to hemisphere, or the locomotive engine rushing with the speed of the storm over the country, how rarely does it occur to us that we are indebted for this rich inheritance to the patient study of the laws of heat? Were I to pursue, into its various directions, the influence which the substitution of steam power for the uncertain forces of water and wind, or for animal force, has exerted on the several arts and manufactures, I should exceed the limits of this sketch; but I am tempted to glance for a moment at the wonderful change which the introduction of steam has produced in the civilization of nations. We are still far distant from the reign of uninterrupted peace; the clang of arms no sooner ceases in one country, than the flames of war are seen raging in another, but how different in form and fashion are our wars from those of antiquity! We still wage war, but no longer for the purpose of enslaving entire nations. We need no slaves, steam engines are our slaves, our helots. The constructions of our architects, and of our engineers, are not less grand than the pyramids of ancient Egypt, whilst they are immeasurably more useful; but no longer are the inhabitants of whole provinces made to groan for years like beasts of burden, no longer is the towering pile cemented by the sweat of an enslaved people.

A harvest of results, not less unexpected, has rewarded the inquiries in electricity, a science of which antiquity had not even an anticipation. A century has not passed since Franklin made his experiments with the electric kite; a shorter time has elapsed since Galvani saw the frog's leg quiver on the balcony at Bologna, and scarcely have the inquiries been completed which place in its true light the connexion between the experiments of both observers; but what incalculable advantage has not the human race already reaped from these observations! Everyone knows that Franklin was led by the prosecution of his experiments to the invention of the lightning-conductor, and that the elaboration of Galvani's observations gave rise to the construction, in the hands of Volta, of his battery, that grand lever of our own times. A faithful handmaid, the voltaic battery multiplies for us, in durable metal, the noblest productions of artistic genius, formerly accessible only to the chosen few, and this with an accuracy of which no other mode is capable. Not satisfied with giving an exact copy of the form, it clothes the copper with a layer of silver or gold, almost imponderable, yet sufficiently close and uniform to protect the delicate surface against the tooth of time. Beaming from the lofty pharos, the electric ray warns the seaman from the treacherous rock, and guides him safely into port. As a winged messenger, lastly, annihilating time and space, the electric current bears our thoughts with the rapidity of their conception over land and under sea. Great as these acquisitions are, the list of benefits which our generation is destined to reap from the study of electricity is not yet concluded. It was by the help of the voltaic battery that Davy, at the commencement of this century, was enabled to decompose the alkalies into

[1] The subject has been very fully treated by Professor Pettenkofer in one of his popular lectures. In the same lecture the author lucidly explains the causes which, in antiquity, prevented the free development of the study of nature.

their elements. The isolation of the alkali-metals has at all times been considered one of the finest achievements of chemistry. During the half century that has since elapsed, it has afforded incalculable aid to the progress of science; but it was reserved for our time to hail on the market-place of life this glorious discovery of Davy. By the help of one of the metals discovered by Davy,—by the help of sodium,—chemists had succeeded in separating from common clay a metal, equally distinguished for its peculiar white lustre, its lightness, and its resistance to the atmosphere. The industrial production of aluminium, which is of unlimited occurrence in Nature, had been impeded hitherto by the high price of the sodium necessary in its extraction. By the unremitting efforts, however, of H. Ste. Claire Deville, the preparation of sodium has lately become so simplified and so cheapened, that the manufacture of aluminium on a large scale has been actively carried on for some time; and thus we owe to the combined inquiries of chemistry and physics, an industry, the future of which it would be difficult at this moment to calculate.

Scarcely less rich and interesting are the acquisitions which modern times have derived from the assiduous inquiries into the nature of light. To the comprehension of its laws, we are indebted for the perfection of the instruments, which, embracing as it were the infinite in both directions, have gathered the vastness of the heavens within the sphere of our perception, and expanded to our view the living world in the water drop. The phenomena of polarization, but a few years ago the exclusive property of abstract science, have taken their place among the adaptations of optics to practical life. Aided by the polarizing prism, the navigator may search the seas for the shoals threatening his destruction, and the fisherman follow the movements of his prey through depths impenetrable to his unaided eye. In the hands of a Biot, a ray of polarized light became, to the sugar manufacturer, an index of the amount of saccharine matter contained in his liquors; whilst directed by the genius of a Wheatstone, we have seen it performing the work of a chronometer. (Playfair.[2])

The method of fixing the picture of the camera obscura, that marvel in the history of science, placed, as it were, on the boundary line between optics and chemistry, directs our consideration more especially to the fruits reaped from chemical inquiry.[3] The study of the solar ray led the way to the contrivance of an instrument, which, imitating the structure of the human eye, presents within a narrow compass a faithful copy of the grandest scenes and of the most fragmentary miniatures of nature and art. To this picture, the fugitive offspring of a passing ray, chemical science has given permanent life. But before this discovery, which is one of the most graceful achievements of our own times, could be accomplished, what thought, what toil was necessary; what a series of researches were required, perfectly unconnected with the final result, which nobody could have anticipated! The ley of the soap-boiler had to give up its iodine: the properties of this new element, and its action on various other substances had to be carefully studied; the investigation of sulphur and its oxides had to teach us the existence and the properties of hyposulphurous acid; gun-cotton, lastly, of ephemeral celebrity whilst threatening the world with destruction, had to be tamed down to the permanent usefulness which it possesses in the form of collodion.

[2] The Study of Abstract Science Essential to the Progress of Industry. "Records of the School of Mines," Part I. 1852.

[3] Some years ago I delivered a lecture on the Importance of the Study of Experimental Science, in a national point of view, at one of the evening meetings of the Royal College of Chemistry. Several of the illustrations given in the text are quoted from this lecture, which was never published, although a small number of copies were circulated among the Members of the College.

Photography is not the only fruit which has arisen from the union of optics and chemistry. The last few months have given evidence of the treasures which are still to be raised on the boundary domains of the two sciences.

It is well known that the spectrum of a flame, of a gas-flame, for instance, in which certain substances are volatilized, exhibits peculiar bright lines, the colour and position of which varies according to the nature of the substance. These phenomena, investigated by several observers, and more especially by Plücker, have lately been further pursued by Kirchhoff and Bunsen. Their experiments have led to truly astonishing results. Not only have these philosophers been enabled to endow science with perfectly new methods of research, in comparison with which the ordinary modes of analysis are coarse and clumsy; but the delicacy of their process has permitted them to recognise the existence of new elementary substances, which, like satelites, accompany the commoner elements. Within the last few weeks they have announced the discovery of a new metal, very similar to potassium, for which they have proposed the name of cæsium, from the Latin word *cæsius*, expressing the peculiar greyish blue colour of the spectrum line, the observation of which gave rise to this remarkable discovery.

I have in the first place directed your attention to the achievements which Chemistry has accomplished in conjunction with her older sister, Physics. Many of the phenomena which constitute the domain of chemistry, have been known for centuries; but it is only in modern times that this knowledge has been raised to the rank of an independent science. Little more than half a century has elapsed since chemical knowledge became chemical science, yet how manifold are the services which this new science has rendered in so short a period! It was in the latter half of the last century that the combined activity of some of the rarest minds working in various countries began to spread light over this field of knowledge. The genius and laborious researches of a Black, a Priestley, a Watt, a Cavendish in this country, of a Lavoisier in France, and a Scheele in Sweden laid the foundations of the grand edifice which has since been raised by the united labours of scientific chemists throughout the world; they were the workers out of the principles of that enlightened method of interrogating Nature, the introduction of which into the arts and manufactures has effected more in the brief space of fifty years, than the unmethodical experiments of many previous centuries had achieved. The "transmutation of metals," and the "*elixir vitæ*," which had eluded the ardour and the perseverance of the alchemist, became the legacy of the scientific chemist, who searched for the philosopher's stone, not in sowing the metals, not in the fragrance of flowers, or in the brilliancy of the morning dew, but in the faithful study of Nature's phenomena, and in the investigation of her laws throughout creation. Modern chemistry has not attempted to convert lead into gold, but what immense sources of individual and national wealth have been opened since the adoption of its methods has infused new life into every branch of industry! On comparing the acquirements of the present age, our comforts, our sanitary regulations, our means of communication, &c., with the state of things in the last century, it may with truth be said that human life has actually gained in duration, while its enjoyments have been increased a thousand fold. It would be both interesting and useful, did this brief sketch admit of it, to notice the effects of chemical knowledge on the various branches of industry in every department of life. It would be found, that not only every art and every trade, but that every individual, had profited by the labours of the chemist.

In taking a retrospect of the rapid progress which some of the arts and manufactures, depending upon chemistry, have made in modern times, we are at a loss to know

where to begin our survey, every branch of industry could furnish the most brilliant illustrations.

Were I to trace with you the history of sulphuric acid, from the moment when the Erfurt monastery first witnessed oil of vitriol passing over, drop by drop, from the alembic of Basilius Valentinus, up to the present time, when hundreds of thousands of tons are sent forth from the colossal lead-chambers of Great Britain alone; were I to enlarge on the influence which chemistry, by raising the production of sulphuric acid to its present degree of perfection, has exerted on the development of chemical manufactures; were I to describe the action of sulphuric acid in the preparation of the other acids, of nitric, hydrochloric, of acetic acid; its application in the manufacture of phosphorus, its employment in the improved process of candle-making, in the isolation of stearin from crude tallow, its use by the dyer for preparing his colours, by the skin-dresser for opening the pores of the skin previous to the operation of tanning; by the metallurgist in the new process of refining silver; by the agriculturist in the preparation of most efficient manures,—I should have to unfold a picture for which it would be difficult to find the appropriate frame. Nor could I omit to show you Leblanc struggling with prejudice for the adoption of his great discovery: the transformation by the agency of sulphuric acid of sea salt into carbonate of soda; or to lead you into the busy factories of Lancashire, which now, after the lapse of less than half a century, provide not only this country, but half the world, with soda. Nor would the picture be complete without the glassworks and the soap manufactories in the distance, the operations of which have been forced into unprecedented activity by the production of soda, without the bleaching yards, which owe their very existence to Leblanc's great discovery!

It would be equally instructive to trace, in brief outlines, the history of coal gas, the manufacture of which has become, during the last thirty years, of truly national importance.

The evolution in different localities of inflammable gases from the ground has been noticed from time immemorial, and the connexion of these gases with deposits of coal had been recognised as early as the middle of the seventeenth century.[4] Years, however, elapsed before correct views of the nature of these gases were established by experiment. In 1739, coal was for the first time subjected to distillation by Dr. Clayton, Dean of Kildare, who thus succeeded in imitating artificially the formation of native gas. From this moment the subject was never lost sight of, but it was not till the end of the last century that the intellectual impulse of that memorable period overcame the difficulties opposed to the practical application of this new source of light. These obstacles we know have been at last entirely removed, gas light is now universal. Our streets, our public buildings, our private dwellings, are brilliant with its radiance. In our daily enjoyments of its benefits, we have almost ceased to be conscious of the comfort and even personal security, which we owe to this, as yet, the best, cheapest, and safest of lights.

But, to the attainment of this end, how many were the scientific problems to be solved, how often had the gas-maker to seek the assistance of the scientific chemist, and to avail himself of the results of his researches, instituted originally perhaps for very different purposes! What a difference between the gas with which Mr. Murdoch lighted up the Soho Foundry in Birmingham, and that now circulating in the arteries of our nightless towns!

The gas produced by the distillation of coal is not an uniform substance. Together with the principal illuminating constituents, light carbonetted hydrogen and olefiant gas, many other gases are evolved during the distillation, some of which, *e. g.* hydrogen, tend rather to diminish the illuminating qualities of the gas, whilst others, as ammonia and sulphuretted hydrogen are injurious to health. This formed a serious obstacle to the adoption of coal-gas as a domestic light. By the aid of chemistry, the composition of coal-gas was ascertained, and the nature of its constituents, useful and deleterious, determined. Founded on the knowledge thus obtained, means were devised for the separation of the latter; the temperature was indicated, at which the purest gas comes over during the process of distillation, whilst for the improvement of gas less rich in illuminating constituents, the beautiful and economical process of naphthalisation was suggested And, finally, simple and elegant burners were contrived for the safe and economical combustion of the product.

The extent to which the use of gas has affected the arts and manufactures in this country can only be conceived by those who are aware of its innumerable applications in the double capacity of giving heat and light. The benefits afforded by gas to our experimental chemists cannot be overrated, more especially in England, where the price of spirits of wine was at one time so exorbitant. But for the use of gas in the laboratory, the progress of chemistry in this country must have been greatly retarded.

In speaking of the general influence of the manufacture of coal gas, it is impossible to leave unnoticed the number of hands daily engaged in raising whole strata of coal, and in loading and navigating the fleets employed in conveying it, not only to the different ports of this kingdom, but to foreign countries, which consume a much larger quantity of English coal for the production of gas than is generally known. The extension of the gas enterprise produced a sensible effect on the iron works by the vast number of retorts, the stupendous gas-holders, and the endless pipes, required for generating, storing, and conveying the gas. Several other branches of trade were also forced into increased activity, and even new trades sprang up in consequence of the extended use of gas. The substances produced in the purification of gas naturally attracted the attention of the gas manufacturer; and chemistry soon pointed out valuable purposes to which they might be applied. The oily matter, which is separated as a secondary product in the distillation of coal, has been the subject of various chemical researches, amongst which must be singled out the elaborate[5] investigations of Charles Mansfield, a young chemist of extraordinary promise, whom a cruel fate tore away to early from science and his friends. His researches showed the more volatile portions of this oil to consist chiefly of benzol, an interesting compound discovered some years previously by Faraday. The history of benzol alone and its uses would fill a little volume. Capable of undergoing in the hands of the chemist an endless number of Proteus-like transformations, this substance has not only assisted the progress of science itself, but given rise to new and important branches of industry. Let me remind you that benzol is the most convenient solvent for caoutchouc; that, as an agent for removing oil and grease, it has become an ordinary household article; that, in perfumery and confectionery, we use it as a substitute for the essential oil of bitter almonds; let me remind you, lastly, that, converted by a succession of chemical processes into aniline, it has given rise to the production of those beautiful mauves, purples, and crimsons in which the lovelier portion of mankind is now indulging to the exclusion of almost every other colour. Nor have the other products of the distillation of coal, which accompany the benzol, proved less useful; the liquid distilling at a very high temperature was found to

[4] Mr. Shirley's experiments on the burning well of Wigan, in the Transactions of the Royal Society for 1659.

[5] Charles Blachford Mansfield died (February, 1855) a victim of his scientific zeal, in consequence of an accident which happened to him whilst he was engaged in experimenting with benzol. The memory of this young man, in whom intellectual powers of the highest order were wonderfully blended with the rarest gifts of the heart, will be cherished by all those who had the good fortune of meeting him during his short but useful career.—A. W. H.

be an efficient preservative of timber, and the pitchy residue formed the chief ingredient of an excellent substitute for the flag-stones of our pavement, while the ammoniacal liquors were found useful in improving the fertility of land. Thus, after the lapse of countless ages, was the nitrogen of petrified fern forests resuscitated in the ammoniacal liquors of the gas-works, to vegetate once more, and increase the produce of our corn-fields.

In giving you a brief outline of the influence which the study of chemistry, by the development of the manufacture of sulphuric acid and of coal gas, has exerted on the progress of civilization of the present time, I have selected as illustrations two branches of industry, which are essentially of modern growth. Let us now glance at the benefits conferred by the development of chemistry on some of the arts, which formed the legitimate pride of antiquity.

Take architecture as an example. In Rome this art had reached the highest degree of perfection. The temples, the theatres, the aqueducts of the Roman architects, half ruined as they have been handed down to us, are justly admired as glorious monuments of their taste, of the vastness of their conception—of their constructive powers. It is generally believed that the Romans have been the inventors of the ordinary mortars, some of their earlier buildings being constructed without the intervention of mortar. They certainly discovered the hydraulic mortars, which they subsequently used in all their marine buildings. The material originally used by the Romans in the preparation of hydraulic mortars, was the volcanic rock which abounds in the neighbourhood of Vesuvius, more especially near the town of Puteoli, the Puzzuoli of modern times. Ground to a fine powder and mixed with slacked lime, the dust of Puteoli, *pulvis Puteolanus*, has the remarkable property of hardening under water. When the Romans penetrated into Germany, they found the same material in the valley of the Rhine and in the volcanic districts of the Eifel. For nearly 2000 years the rocks of Puzzuoli and the trass-quarries of the Rhine were the only sources from which this valuable article could be derived. It was reserved to the science of our own age to unravel the mystery of hydraulic mortars. The attention of scientific inquirers was forcibly drawn towards this subject, when, at the close of the last century, Parker and Wyatt made the important discovery that the calcareous nodules, which are found in the clay of the London basin may be converted by simple burning into an excellent hydraulic mortar, which had, moreover, the advantage of requiring no addition of lime. Patented in 1796, this discovery led to an important branch of industry—to the manufacture of "Roman cement." The question of hydraulic mortars had entered upon a new phase by becoming the subject of scientific investigation. Geology and chemistry were appealed to, and it was not long before a satisfactory answer was obtained. Several observers have participated in this examination, but it was not until a prize, proposed by the Society of Harlem, elicited in 1828 the classical inquiry of Fuchs, and based the production of artificial hydraulic cements upon a scientific foundation. It would transgress the limits of this fugitive sketch were I to trace, step by step, the gradual development of the chemical theory of hydraulic cements; the question has been very ably discussed by Professor Pettenkofer,[1] who in our own days has materially assisted in the final elucidation of this subject. Suffice it to say that the conditions involved in the solidification of water-mortars are now known, and that every country possesses the materials for the artificial production of what was once the monopoly of the Bay of Naples and the valley of the Rhine.

(To be continued.)

[1] Popular Lecture.

NOTICES OF PATENTS.

Manufacture of Alloys of Titanium and Iron. Improvements in the Manufacture of the same Alloys. Robert Mushet.

These specifications refer to modes of treatment for the reduction of an alloy of iron and titanium from the magnetic iron-sand, which occurs so abundantly in the neighbourhood of Taranaki, New Zealand. Mr. Mushet proposes to overcome the difficulties which stand in the way of successfully reducing this ore in the ordinary blast furnace by incorporating the titaniferous iron-sand either with pitch, tar, resin, or bitumen, previously to its introduction with the fuel (coke or charcoal) into the blast furnace or cupola. Mr. Mushet claims, also, the production of an alloy of titanium and iron from the compound ores of titanium, termed "ilmenites" by mineralogists. The advantages anticipated in the above mode of treatment will consist, firstly, in the more appropriate state of aggregation of the powdery iron ore prior to its introduction into the furnace, thus preventing the choking of the air-passages in the fire, which has always been the consequence of attempting to employ the iron-sand in its natural condition; secondly, the intimate incorporation of the finely divided ore with carbonaceous materials would be calculated to facilitate the reduction of the iron, and with it some of the titanium also present in the compound ore.

Improvements in the Manufacture of "Iron and Steel" and of "Cast Steel." Robert Mushet.

These patents have reference to the alloying of titanium-iron with either cast steel, puddled steel, or with sundry products of the iron refinery furnace. The intention of the patentee is to produce from iron in various degrees of carbonisation superior descriptions of steel and other metals having valuable properties.

Improvements in the Construction of Furnaces for Melting Glass. W. Pilkington.

This invention consists in the adaptation of a steam boiler to the ordinary form of glass furnace. An arrangement of iron pipes is made to deliver jets of steam into the caves beneath the furnaces, where they are caused to impinge upon the lower surfaces of the grate-bars, with the two-fold object of keeping them cool, and of supplying steam mingled with air to sustain the combustion of the fuel.

Improvements in the Manufacture of Paper. T. Richardson, Newcastle-on-Tyne.

Mr. Richardson proposes to mix with the ordinary pulp for paper-making, certain phosphates, employed either alone, or conjointly with sulphites. The phosphates of lime and magnesia are particularly specified. This admixture is intended to supply mineral matter to the paper, and to be used as a substitute for gypsum and kaolin; the excessive proportion of which in some descriptions of paper has recently been pointed out in the Chemical News.[2] Less gritty than kaolin, the phosphate of lime would be found very similar in character to the sulphate (gypsum), and when employed in moderate amount would probably be considered a legitimate mineral ingredient in paper-making.

Improvements in Treating Bye-Products arising in the Manufacture of Soda and Potash for the Attainment of Anti-chlores, and other useful Products. J. Townsend and J. Walker, Glasgow.

The patentees expose the waste oxy-sulphide of calcium (obtained in soda-works) to the action of atmospheric air,

[2] Chemical News, Vol. III. p. 329.

whereby they obtain hyposulphite and sulphite of lime. The peculiar manner of effecting this conversion constitutes their first claim. The sulphite and hyposulphite of lime resulting are used in combination with either of the sulphates of soda, potash, ammonia, or magnesia, for producing paper makers' antichlore. The insoluble portion of the oxidised waste is treated with caustic or carbonate of soda or potash to furnish sulphite of soda or potash. And, finally, the patentees claim the obtaining of sulphur and oxides of manganese; also a bye-product in the alkali manufacture.

Manufacture of Gas. W. CLARK. (A Communication. Not proceeded with.)

IN this invention it is proposed to introduce hydrogen gas into the retorts used for the distillation of coal, and by this means so to dilute the illuminating gas as to prevent in a great measure its decomposition by contact with the red-hot inner surfaces of the retort. The hydrogen is to be stored in a separate gas-holder and passes thence through an iron pipe set across the furnace in a position where it may receive the waste heat. The hydrogen thus becomes moderately heated before it enters the gas-retort, and there combines with the highly illuminating gaseous products disengaged during the distillation of the coal.

CORRESPONDENCE.

The Sale of Poisons.

To the Editor of the CHEMICAL NEWS.

SIR,—It afforded me great pleasure to read the letter of your correspondent, W. Bennington, on the sale of poisons. It is very deplorable that a subject of so much importance as this should have been dropped, and so easily forgotten. I hope now that it is again agitated, it will not be deserted without some practical benefit having been derived from it. I quite agree with him that all future chemists should pass an examination testing their ability. In answer to the objection raised, that this would be a work of time, and that it would be no guarantee that those who are at present in business are competent to fulfil the duties required of them by the public. I reply, it need not be a work of so long a time as many suppose. Suppose that a Society were formed for the examination of chemists as to their competency to vend drugs and poisons, and a Bill passed with the following clauses:—

1st. That no person should commence the business of chemist and druggist who had not passed the above Society and obtained a certificate of his competency.

2nd. That no young man should be accepted as assistant who had not passed and obtained a certificate.

3rd. That all apprentices should pass, prior to the expiration of their term of apprenticeship.

4th. That all chemists under a certain age (suppose 35 years) should pass an examination within one year after the time of the Bill passing.

5th. That if any one should sell drugs, or call himself a chemist or druggist, without having obtained a certificate, he should pay a certain fine.

6th. That each candidate should be examined in Latin, as far as requisite for a correct translation of prescriptions, &c., and in the nature and medicinal properties and dose of each medicine, &c., &c.

7th. That each candidate should pay a certain sum for each examination.

8th. That each candidate should, if unsuccessful the first time, offer himself three other times, and that three months should expire between each examination.

9th. That each member should pay a small subscription annually to defray the expenses of the Society.

Of course, Sir, other clauses would be requisite, which I leave for some of your readers more competent than myself to add; no doubt it will be a hard struggle, and much must be done before this can be accomplished, but as unity makes strength, let us unite and give a strong pull, and we shall at last come off victorious. I doubt not that such a Society, protected and sanctioned by Government, would be the only means for lessening the many deplorable cases of poisoning which daily present themselves to our view. Many would object to such a Society; but I think no educated chemist would, only those who have never spent one day in studying the properties of those drugs which they daily sell. I am not merely surmising such to be the case. I know many that have walked out of a factory into a "Chemist's" shop, and have taken the title of "Dispensing Chemists," whilst they know nothing about the doses and properties of those drugs which they daily sell. I am personally acquainted with many cases of poisoning, resulting from the fact that such ignorant persons are allowed to sell such dangerous medicines, without knowing or giving the proper caution; but have there not been sufficient already to act as a strong and powerful stimulant to induce us to do something, and to cry to each slumberer, Rise, come to help us? I hope that others of your readers will take the subject up, and that soon something may be done to lessen this great evil. I do not wish, Sir, that anyone should suppose that I mean the beforenamed clauses to be arbitrary, far from it. I only offer them as rough timber which requires to be planed and formed into a noble edifice by some clever builders, into which we may run for protection. Having no apology to make, save the importance of the subject,—I am, &c.

R. J. RUTTER.

Uttoxeter.

[Our correspondent seems to be unaware that the Pharmaceutical Society has been labouring for years to do nearly all he suggests, and has so far obtained an Act of Parliament, which gives an exclusive right to the title "Pharmaceutical Chemist" to gentlemen passing the examination of the Society. Further power than this it is not likely, nor perhaps advisable, that the Society should obtain; but we may add that a movement is on foot which will place the question before Pharmaceutists and the Medical Profession in a new light, and it is to be hoped will result in some legislation on the matter. The subject will receive full development in our pages in a short time. —ED. C. N.]

Sulphuric Acid.

To the Editor of the CHEMICAL NEWS.

SIR,—Some years ago I required a large quantity of pure sulphuric acid, and after some considerable trouble devised a method of preparing it, which afforded me six Winchester quarts daily. Had I required ten times the amount it might easily have been prepared, and if your Subscriber will communicate with me, we may come to an arrangement on the subject.—I am, &c.

JOHN HENRY PEPPER.

Laboratory, Marylebone Institution,
17, Edward Street, Portman Square.

Chemical Notices from Foreign Sources.

TECHNICAL CHEMISTRY.

Green Colours.—Some green colours free from the objections which apply to the arsenical greens are described by Elsner (*Elsner's Chem.-Tech. Mittheil für* 1859-60. *Polytech. Centralb.* 1861, s. 494). The first called "Elsner"

green," is made by adding to a solution of sulphate of copper a decoction of fustic, previously clarified by a solution of gelatine; to this mixture is then added 10 or 11 per cent. of protochloride of tin, and lastly an excess of caustic potash or soda. The precipitate is then washed and dried, whereupon it assumes a green colour with a tint of blue.

The "Tin-copper Green" is a stannate of copper, and possesses a colour which Gentele states, is not inferior to any of the greens free from arsenic. The cheapest way of making this, is to heat fifty-nine parts of tin in a Hessian crucible, with 100 parts nitrate of soda, and dissolve the mass when cold in a caustic alkali. When clear, this solution is diluted with water, and a cold solution of sulphate of copper is added. A reddish-yellow precipitate falls, which on being washed and dried, becomes a beautiful green.

Titanium Green was first prepared by Elsner in 1846. It is made in the following way:—Iserin (titaniferous iron) is fused in a Hessian crucible with twelve times its weight of sulphate of potash. When cold, the fused mass is treated with hydrochloric acid, heated to 50° C. and filtered hot; the filtrate is then evaporated until a drop placed on a glass plate solidifies. It is then allowed to cool, and when cold, a concentrated solution of sal-ammoniac is poured over the mass, which is well stirred and then filtered. The titanic acid which remains behind, is digested at 50° or 60° with dilute hydrochloric acid, and the acid solution, after the addition of some solution of prussiate of potash, quickly heated to boiling. A green precipitate falls, which must be washed with water acidulated with hydrochloric acid, and then dried under 100° C. Titanium green then forms a beautiful dark green powder.

Platinum Coating for Porcelain Crucibles.—Elsner gives the following (*Elsner's Chem. Tech. Mittheilungen*, 1859-60, s. 124) as a method by which a strong covering of metallic platinum may be given to porcelain vessels. Platinum-black is rubbed up with oil of turpentine, and the mixture is painted over the object to be coated, made red-hot. The vessel coated is then enclosed in a capsule, and well burnt in a furnace, after which it will be found perfectly covered with a strongly fixed covering of metallic platinum.

Platinum black was found to be fusible in the strongest heat of the furnace oven in the Royal Porcelain Manufactory at Berlin.

Manufacture of Pure Phosphoric Acid.—Dr. J. Neustadtl publishes (Dingler's *Polytech. Journal*, Bd. clix. s. 441) an "improved method of making pure phosphoric acid on the large scale." The process involves the preparation of phosphate of soda from bone ash, the formation of phosphate of baryta from this, and the subsequent decomposition of the last by sulphuric acid. In the first place, one part of finely powdered bone ash is mixed with four parts of water and one part hydrochloric acid. After standing six hours, the clear liquid is poured off, and to it is added a boiling solution of sulphate of soda. The sulphate of lime is allowed to deposit, the liquor is poured off, and the precipitate washed and pressed. The liquor decanted, which contains acid phosphate of soda, chloride of sodium, and some sulphate of lime, is now boiled with carbonate of soda and rendered neutral, and then filtered from the precipitated carbonate of lime. We have now a neutral solution of phosphate of soda and chloride of sodium, to which is added just enough of a hot solution of chloride of barium to precipitate the phosphoric acid in the form of phosphate of baryta. Twice the weight of the bone-ash operated on, the author says, is the quantity of chloride of barium required. After well washing, the phosphate of baryta (prepared from one part of bone-ash) is mixed with one part of sulphuric acid diluted with three parts of water, and stirred occasionally for two or three days, until no sulphuric acid is found in the liquor, which is then strong and pure phosphoric acid.

White Gunpowder.—Dr. J. J. Pohl has improved on Augendre's white gunpowder (*Sitzungsb. du Akad. der Wissenschaft zu Wien.* Bd. xli. s. 634). He prescribes the following quantities:—

Ferrocyanide of potassium . . .	28 parts
Cane sugar	23 ,,
Chlorate of potash	49 ,,
	100

which give a well-burning powder, and nearly approaches the proportions

$K_2 Fe Cy_3, 3 HO + C_{12} H_{11} O_{11} + 3 (KO Cl, O_5)$.

The results of the combustion of this mixture he calculates to be: $2 K Cy + 3 K Cl + Fe C_2 + N + 6 CO + 6 CO_2 + 14 HO$: or 100 parts by weight of the powder is resolved into

47·44	gaseous bodies
52·56	solid residue
100·00	

The volumes of the gaseous bodies he estimates as follows:—

Nitrogen	1927·0 C. C.
Carbonic oxide	8942·9 ,,
Carbonic acid	8942·9 ,,
Steam	20867·6 ,,
	40680·4 C. C.

Compared with ordinary gunpowder, considered as unity, the results are said to be:—

	Ordinary Powder.	White Powder.
Volume of gas set free. . .	1	2·107
Temperature of flame . .	1	0·641
Residue	1	0·77

It should seem, then, that the new powder has over the old the advantages of greater power, igniting at a lower temperature, and leaving less residue. The author points out several other advantages: the ease with which the white powder is manufactured, there being no necessity for granulating and glazing, and the less danger of accidents. The higher price of the materials he considers is more than compensated for by the smaller quantity required.

A political and literary contemporary who dabbles a little in science, and who describes the above composition as being *equally white and cleanly with common gunpowder*, dismally prophesies innumerable accidents if white powder should ever come into use, in consequenee of the explosive nature of chlorate of potash—a danger to which he, with wonderful prescience, says, the author has never alluded. As it happens, Dr. Pohl is at pains to show that fears like those of our contemporary are groundless. Only, he states, the heaviest stroke of iron upon iron is sufficient to produce an explosion, and that it is impossible to ignite the powder by rubbing it between wood and metal, or between stones.

ANALYTICAL CHEMISTRY.

Estimation of Carbon in Organic Substances.—Dr. W. Knop proposes (*Chem. Centralblatt*, No. 2, 1861, s. 17) the following improvement on Brunner's method of estimating carbon, in the moist way. He found that when organic matter was heated with a solution of chromic acid, the carbonic acid was evolved so rapidly that it was imperfectly dried in the chloride of calcium tube, and not all taken up in the potash bulbs. He, therefore, first collects the gas in an india-rubber bag, and then passes it quietly through the chloride of calcium, and into the potash apparatus. This is done by fitting up a flask with two tubes bent at right angles, the end of one of these tubes is drawn out and closed; the end of the other is fitted to the india-rubber bag, which must be of an elliptical shape,

and open at both ends, that end adapted to the chloride of calcium tube being shut for the time by a clip. The substance to be analysed is then placed in the flask with a cold mixture of diluted sulphuric acid and bichromate of potash. Heat is now applied to the flask, whereupon carbonic acid is given off, and passes into the bag. When the decomposition is ended the clip is removed, and the gas is gently forced through the chloride of calcium tube and into the potash. The closed tube is then connected by means of an india-rubber tube to a gas-holder filled with air (freed from carbonic acid), the end of the glass is broken off within the tube, and air is passed quietly through the apparatus, carrying with it the last traces of the carbonic acid. Dr. Knop says that he has in this way analysed oxalic and tartaric acids, milk, sugar, and other bodies, and obtained the best results.

MISCELLANEOUS.

Royal Institution of Great Britain.—At the General Monthly Meeting, held on Monday, July 1, 1861, William Pole, Esq., M.A., F.R.S., Treasurer and Vice-President, in the Chair, William Beckett, Esq., Alexander John Ellis, Esq., Hardinge Giffard, Esq., and Joseph Neuberg, Esq., were elected Members of the Royal Institution. John Dobie, Esq., W. H. Stoné, Esq., and D. J. Wainwright were admitted Members of the Royal Institution. The Secretary announced that the Fullerian Professorship of Physiology was vacant, and that the Managers would appoint a Professor on May 12, 1862. The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

The Boiling-points of Different Liquids.—The laws relating to the boiling-points of different liquids at the ordinary pressure of the atmosphere have lately been investigated by Mr. Tate, and the results of his experiments are published in the *Philosophical Magazine*. He has made experiments with solutions containing the chlorides of sodium, potassium, barium, calcium, and strontium; the nitrates of soda, potassa, lime, and ammonia; and the carbonates of soda and potassa. He has found for all these salts that the augmentation of boiling temperature may be approximately expressed in a certain power of the per-centage of the salt dissolved. The salts enumerated may be divided into four distinct groups; namely, first, the chlorides of sodium, potassium, and barium, and the carbonate of soda; second, the chlorides of calcium and strontium; third, the nitrates of soda, potassa, and ammonia; fourth, the carbonates of potassa and nitrate of lime. In each of these four groups, the augmentations of boiling temperature of the solutions have a constant ratio to one another for an equal weight of salt dissolved. He has also ascertained by experiments that for an equal weight of salts, the boiling temperatures are (approximately) in the inverse ratio of the chemical equivalents of their bases, and in the case of the nitrate of lime and the carbonate of potassa with the equivalents of the entire salts. Although the law thus indicated is not strictly true, it is sufficiently exact to warrant further inquiry, and the cases in which it is found to apply are too numerous to be referred to accidental coincidence. Future researches may extend these laws to other substances, as it is quite consistent with analogy to suppose that the chemical composition of a substance affects the boiling temperature of its solution. It will readily be acknowledged that the prosecution of these experiments may throw additional light upon the generation of steam, the economy of fuel, and kindred questions of great practical importance to engineers.

Artificial Manure from Newfoundland. — Manure, which may now be considered as an article of Newfoundland trade, is manufactured on Massacre Island, at St. Pierre's, in the following manner:—Old herring bait, at a cost of two francs per barrel, is salted with foreign salt, then boiled in a furnace, containing 250 gallons, for three hours; when cold, put into thick round mats, made for the purpose, about two feet in diameter, then placed under a screw, about twelve of them at a time, for twenty hours, by which process the water and oil are pressed out; these run by means of a shallow trough and conducting spouts, to casks outside the building, after which the oil floats, and is taken off, yielding about five per cent.; the mats containing the herring are put out, after pressing, to dry for two days: it is then taken from the mats, put into flour barrels, and closely packed by treading upon it; some is put into boxes containing 224 lbs. each; the barrel contains about the same weight. Caplin are made into manure as above, but do not produce oil. Cods' heads, also in the same manner. Cods' heads are also well dried on a beach, for five days or a week, without any salt. They are then packed into flour barrels, screwd in and sent to France, where they are ground up for manure. All these manures are said to be better than guano, and fifty per cent. higher in price. Mussels, oysters, bones, kelp—I saw specimens of all these manures, ground to a powder, said to be equally as good as any other kinds. In the manufactory, which is about sixty feet long by forty wide, I saw thirty screws fixed in frames, over troughs, say five in each frame. Forty men were here employed last year, but now less, on account of some having been lost coming out the last spring; the establishment could manufacture twenty tons per day with more room. Three hundred tons are sent to France; the island is not large enough to carry it on to the extent desired. There are no mills at present for grinding, but it is intended to import some next year, and fully complete the manufacture at St. Pierre's. If these manures pay and answer at so great a distance as France, why should they not answer the inland agriculture of Newfoundland?

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. III. of the Chemical News, containing a copious Index, is now ready, price 10*s.*, 8*d.*, by post 11*s.* 4*d.*, handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our Office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* if sent to our Office, or, if accompanied by a cloth case, for 6*d.* A few copies of Vols. I. and II. can still be had, price, respectively, 10*s.* 6*d.*, and 12*s.*, or by post 11*s.* 2*d.* and 12*s.* 8*d.* Vol. IV. commenced with No. 83 on July 6, 1861, and will be completed in 26 numbers.

The New Part for June (published June 1) is also ready, price 1*s.* 9*d.*

Binding Vol. III.—A Subscriber is informed that there is not the slightest necessity to bind up any of the advertisement pages with the matter of the volume. None of our own volumes are so bound, and no intelligent binder would, unless expressly ordered to do so, bind up any advertisement pages, they being printed, paged, and folded with the express purpose of being left out of the bound volume.

The Coal-Tar Colouring Matters.—In answer to numerous applications, we beg to state that the number of the Chemical News containing Mr. Perkin's lecture on Colouring Matter can be had on application at the Office.

R. S. T.—Cotton and Johnson, Grafton Street, Soho, or Johnson and Matthey, Hatton Garden, will supply you.

E.—Distil it by means of steam, keeping the temperature below 212° F.

Alimentum Salutaris.—We shall always be happy to receive letters from this correspondent, but we have an objection to reprinting letters which have already appeared in contemporary journals.

Chemicus Junius.—You are quite correct in saying that the popular process for detecting alum in bread will show its presence if alum be there. It is however open to the objection that it is equally certain to show the presence of alum when *none* is in the bread.

Cut Flowers.—A little camphor in the water will preserve cut flowers for some days longer than if plain water were used.

THE CHEMICAL NEWS.

VOL. IV. No. 84.—July 13, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Weighing of Moist Precipitates, by FERDINAND F. MAYER.

MR. CH. MENE, of Creusot (*Journ. de Pharm. et de Chimie*, Oct., 1858) gives a mode of weighing which does away to a great extent, with the tediousness and difficulties attending the drying of many precipitates, especially in volumetric analysis. He washes the precipitate thoroughly by decantation, and then introduces it carefully into a bottle, the exact weight of which, when filled with distilled water at a certain temperature, is known. Since the precipitate is heavier than water, the bottle when filled again will weigh more than without the precipitate, and the difference between the two weights furnishes the means of calculating the weight of the precipitate.

In case the precipitate settles but slowly, it may be collected on a filter, and, together with the filter, after washing, be introduced into the bottle, in which case the weight of the filter and its specific gravity, supposing any difference should exist between its own and that of water, is to be taken in account. Precipitates soluble in or affected by water may be weighed in some other liquid.

This method, of which the above are the outlines, is spoken of in the *Jahresbericht der Chemie* for 1858 in rather disparaging terms, and I consider it not more than justice to the method, if not also to Mr. Mène, to prove its correctness, the more so as I have applied the principle on a large scale as far back as 1855.

I engaged in that year in the manufacture of carbonate of lead from refuse sulphate of lead, by treating the latter, in a pulpy condition, with carbonate of soda. The sulphate of lead I used contained very varying proportions of water and soluble impurities, from which latter it had first to be freed by washing. It was then in the state of a thin pulp, and the difficulty was to find the amount of the dry sulphate of lead, as it was a matter of importance to use as little carbonate of soda, and to obtain as pure a carbonate of lead and sulphate of soda as possible. This could only be done by weighing it as whole, or in portions, but as the drying of a tubful of sulphate of lead (from 500 to 1200 lbs.) was impracticable, and sampling not less so, since the upper strata contained a much larger proportion of water than the lead at the bottom; I contrived the following method, which enabled me to leave the management of the process in the hands of a workman:—

I took a strong oaken pail, weighing 8 lbs. when empty, and caused a black mark to be burnt in horizontally around the inside of the pail, two inches below the rim, up to which mark it held 20 lbs. of water. I reasoned as follows:—The specific gravity of sulphate of lead being 6·3, the pail, if filled up to the mark, would hold 126 lbs. of pure sulphate of lead. The specific gravity of water being 5·3 less than that of sulphate of lead, it followed that if there was 1 lb. of water in the pailful of moist sulphate, the pail would weigh 5·3 lbs. less than 126 (+8, the tare of the pail) = 120·7 (+8); if there were 2 lbs. of water present, the weight would be 115·4 (+8), and so on. This enabled me to calculate a table, giving in one column the actual weight of the pail when filled with moist sulphate, and opposite, in a second column, the amount of dry sulphate corresponding to the gross weight. The weight of dry sulphate was thus found as accurately as could be desired, although the amounts varied in practice from 30 to 105 lbs.

It is nothing but an application of the Archimedean theorem, that when a solid body is immersed in a liquid it loses a portion of its weight, equal to the weight of the fluid which it displaces, or to the weight of its own bulk of the liquid.

This, as I suppose, is precisely the principle applied by Mr. Mène. The precipitate he obtains by a certain chemical manipulation is a substance of known composition and specific gravity. Supposing it to be sulphate of lead, and the bottle, when filled with water at the normal temperature, to weigh 70 grammes = 50 grammes of water, and 20 for tare. After introducing the precipitate and filling again with water it weighed 71·06 grammes. Now, as the specific gravity of sulphate of lead is 6·3, or as the weight of a cubic measure of sulphate of lead is 6·3 times that of a cubic measure of water, and as the space of one part by weight of water is taken up by 6·2 parts by weight of sulphate of lead, it follows that the quantity of sulphate of lead in the bottle, which has taken up the space of one part by weight of water, increases the original weight of the bottle (filled with pure water) by 5·3. To find the amount of water displaced, it is only necessary to divide the overweight (1·06 grammes) by 5·3 = 0·2, which, added to the overweight 1·06 + 0·2 gives 1·26 grammes as the weight of the precipitate.

Hence the rule, which is of great convenience in volumetric analysis, that to find the weight of a moist precipitate, which is a compound of known specific gravity, weigh it in a specific gravity bottle or some other vessel of known weight, when filled with water, or any other liquid, at the normal temperature, again fill it with the water or other liquid, divide the excess of the new weight by the specific gravity of the substance, less that of the water or other liquid (that of water being = 1), and add the quotient to the overweight, which gives the weight of the precipitate.

The Editor of the *Jahresbericht* appears to have overlooked the fact that the precipitates weighed in this manner are definite compounds, the specific gravity of which is well ascertained.

The principle I have exemplified above may not be novel; but as I have never met with it, chemists, as well as manufacturers, especially of colours, will probably

also find it of interest, and certainly highly practicable and easy of execution.—*Am. Journ. Science and Arts.*

Boracic Acid in the Sea-water of the Pacific on the Coast of California, by John A. Veatch.

The existence of boracic acid in the sea-water of our coast was brought to my notice in July, 1857. I had, in the month of January of the previous year, discovered borate of soda and other borates in solution in the water of a mineral spring in Tehama County, near the upper end of the Sacramento Valley. Prosecuting the research, I found traces of boracic acid—in the form of borates—in nearly all the mineral springs with which the State of California abounds. This was especially the case in the coast mountains. Borate of soda was so abundant in one particular locality that enormous crystals of that salt were formed at the bottom of a shallow lake, or rather marsh, one or two hundred acres in extent. The crystals were hexahedal with bevelled or replaced edges, and truncated angles; attaining the size, in some cases, of four inches in length by two in diameter, forming splendid and attractive specimens. In the same neighbourhood, a cluster of small thermal springs were observed holding free boracic acid in solution. A few hundred yards from these, a great number of hot springs, of a temperature of 212° F., rose up through the fissures of a silicious rock. These springs held a considerable quantity of borax, as well as free boracic acid. Many other localities furnished similar indications, but in a less extensive form.

In progress of the examination I found that the common salt (chloride of sodium) exposed for sale in the San Francisco market, and which, it was understood, came from certain deposits of that article on the sea-margin in the southern part of the State, also furnished boracic acid. I was led to attribute it to the fact of mineral springs emptying into the lagoons furnishing the salt. It was, therefore, a matter of no small surprise, when on a visit to the localities, I found no trace of acid in any of the springs in the adjacent district. This led to an examination of the sea-water, and a detection of an appreciable quantity of boracic acid therein. It was at Santa Barbara where I first detected it, and subsequently at various points from San Diego to the Straits of Fuca. It seems to be in the form of borate of soda, and perhaps of lime. The quantity diminishes toward the north. It is barely perceptible in specimens of water brought from beyond Oregon, and seems to reach its maximum near San Diego.

This peculiarity seems to extend no great distance seaward. Water taken thirty or forty miles west of San Francisco gave no trace of acid. In twelve specimens taken at various points between this port and the Sandwich Islands, furnished me by Mr. Gulich, of Honolulu, only that nearest our coast gave boracic acid. In ten specimens kindly furnished me by Dr. W. O. Ayers, taken up by Dr. J. D. B. Stillman, in a trip of one of the Pacific mail steamers from Panama to this place, no acid was discovered south of the Cortez Shoals.

I have not as yet been able to obtain specimens of water south of San Diego, nearer the shore than the usual route of the mail steamers. Neither have I been able to test the breadth of this boracic acid belt any further than the fact above stated, of no acid being found at the distance of thirty or forty miles west from the Golden Gate. I think it probable that it is confined within the submarine ridge running parallel with the coast, the southern portion of which is indicated by certain shoals and island groups. The source of the acid is undoubtedly volcanic, and the seat of the volcanic action is most likely to exist in this submerged mountain range. It strengthens the probability of the eruptive character of the Cortez Shoal.

I hope in future to be able to make more accurate and extended examinations, unless some one more capable of doing justice to the subject should take it in hand. With this view, I solicited the attention of Dr. J. S. Newberry to these facts while he was in this city, on his way to join Lieutenant Ives' Colorado Exploring Expedition, hoping he might think it worthy of investigation during his stay on this coast.—*Proc. Cal. Acad. Nat. Sci.*

TECHNICAL CHEMISTRY.

On the Origin and Progress of the Phosphorus and Match Manufactures, by G. Gore.

It has been wisely remarked, that Science "teaches us to be neglectful of nothing; not to despise small beginnings, for they precede, of necessity, all great things in the knowledge of science, either pure or applied." Not only should we not neglect scientific knowledge, but we should nurse as it were the smallest scientific truth; trying and watching the influence of various conditions upon it; increasing its distinctness or importance by modifying the surrounding circumstances; adding here a little and there a little, in order to magnify the extent or variety of its applications to human benefit. It is by such processes of treatment as this, slow and certain, that the little facts of the bygone alchemists, and of the more modern scientific investigators, have been extended and elaborated into the marvellous and magnificent realities of the present day.

Nearly all the great practical results of science of this period have had their origin in apparently useless and out-of-the-way observations. The expansive power of steam was known long before it was applied to any useful purpose. One observed and another observed the influence of various circumstances upon it; one invented and another contrived additional means of controlling it and directing it; one added and another introduced contrivances and pieces of accessory mechanism to increase its power; until from the simple and apparently useless fact of vapour expansion, it has grown to be the giant power of the earth, influencing the actions and habits of nearly all mankind.

The curious facts respecting the action of liquids on metals, observed by Volta and Galvani, and the action of electric currents on magnets, have, by the repeated trials and applications of subsequent discoverers and inventors, been elaborated into the present system of electro-telegraphy, which bids fair to cover the whole earth with its wires and to bring every human being into speaking distance with each other.

No reasonable and intelligent person can compare the commencements of these things with their present developments without being impressed with the insignificance of their origin and the magnificence of their practical results, nor without being convinced of the importance of abstract scientific investigation. It is not my object on the present occasion to dilate upon the relations of abstract science to manufactures and practical life, but to give some account of the origin, progress, and present condition of the phosphorus and match manufacture.

In the year 1669 phosphorus was accidentally discovered in human urine as "a dark, unctuous, daubing mass," by Brandt, a merchant and alchemist, of Hamburg, while searching for a liquid capable of transmuting silver into gold. By some means it appears that at the same time Kunckell, a German chemist, gained some knowledge of the means of obtaining this substance, and communicated it to Kraft, of Dresden, who proceeded to Hamburg and paid 200 dollars for a specimen "for him to make demonstrances to princes." Kunckell prepared some of the substance and exhibited it to the Courts of Saxony and Brandenburg, although it was not a very delicate or agreeable exhibition, "because the unctuous and daubing oyliness was not yet accurately separated from it, and, without doubt, it was very stinking, and therefore unpleasant." He also gave some to his friends, Professors in Germany, and to Mr. Linck, of Leipsic, for sale. An account of it was published in his "Laboratorium Chymicum," Hamburg and Leipsic, 1716, p. 660.

To afford some idea of the effect of Brandt's discovery upon his fellow-townsmen and upon alchemists generally I quote the following:—"When, now, such like noble motives made that good old man Brandt to broil and to sweat much more by his excrements, one may easily guess how much at that time the whole heaven of Hamburg did hang full of fiddles as he brought forth out of it a lumen which, in the world, is counted the most perfect *agens intrinsicum*. There was then cried nothing but triumph and victory among the chymists. Those good people erected already in their thoughts so many hospitals and poor-houses that no beggar should ever more molest any man in the streets, made great legacies, and pious causes, and what not else." "Besides, the other alchymists did encourage him yet more, and desisted not to make him believe how this was that same fiery ghost of Moses that in the beginning moved upon the water, yea, his splendid shining face: the fiery pillar in the desert, that secret fire of the altar wherewith Moses burned the golden calf before he strewed it upon the fire and made it potable."

About the year 1670 the Honourable Robert Boyle, an Irishman and a philosopher of this country, brought over from Germany a youth named Ambrose Godfrey Hanckwitz to assist him in his chemical experiments, and having obtained information from Saxony of the method of extracting phosphorus, directed his assistant, Mr. Bilger, to instruct Hanckwitz to prepare some of it. Hanckwitz it appears succeeded in preparing an ounce of the substance and presented it to his master even before he received the instructions from Mr. Bilger. He was now sent by Boyle on a tour through "Holland, Italy, Naples, and Germany," to gain further information respecting "the marvellous lumen," but with little success, for he returned without meeting with "even one that could make even that poor daubing stuff as Kunckell's out of the usual microcosmical matters."

In No. 135 of the *Philosophical Transactions* of the Royal Society, dated March 26, 1677, page 87, is a paper by Boyle, entitled, "An Account of Four Sorts of Factitious Shining Substances, communicated to the publisher from very good hands, both in printed papers and in letters not printed." After speaking of three sorts, it says:—"The other is Phosphorus Fulgurans, which is a matter, made both in a liquid and dry form, and not only shineth in the dark and communicates a sudden light to such bodies as 'tis rubbed upon, but being included in a glass vessel, well closed, doth now and then fulgurate, and sometimes also raise itself as 'twere into waves of light. Differing from the Balduinian stone, which is to be exposed to some shining body, as the day, the sun, the fire, or some lighted candle, to receive light from these, whereas this fulgurating substance carries its light alwaies with it, and when put in a dark place presently shews the same. Of which we have this further assurance given us, that a little portion of it having been kept two whole years hath not yet lost its power of shining. So that 'tis believed if a considerable big piece were prepared of it, it would serve for a perpetual, or, at least, a very long lasting light."

In No. 150 (August 10, 1683), p. 289, is also given "An Account of some Experiments made at several meetings of the Royal Society by the injenious Frederick Slare, M.D., F.R.S., and one of the Royal Colledge of Physicians, with some short applications of them to physical matters." He gives "A Parrallel betwixt Lightning and a Phosphorus," and relates a number of experiments of adding phosphorus to oil of vitriol, water, oil of turpentine, and oil of petroleum, producing combustion, &c.

And in No. 196, p. 579, dated January, 169$\frac{2}{3}$, is "A paper of the Honourable Robert Boyle's, deposited with the Secretaries of the Royal Society, October 14, 1680, and opened since his death, being an account of his making phosphorus, &c." "September 30, 1680. There was taken a considerable quantity of man's urine (because the liquor yields but a small proportion of the desired quintessence), and of this a good part at least had been for a pretty while digested before it was used. Then this liquor was distilled with a moderate heat, till the spirituous and saline parts were drawn off, after which the superfluous moisture also was abstracted (or evaporated away), till the remaining substance was brought to the consistence of a somewhat thick syrup, or a thin extract. This done, it was well incorporated with thrice its weight of fine white sand, and the mixture being put into a strong stone retort, to which a large receiver (in good part filled with water) was so joyn'd that the nose of the retort did almost touch the water. Then, the two vessels being carefully luted together, a naked fire was gradually administered for five or six hours, that of that was either phlegmatick or volatile might come over first. When this was done the fire was encreased, and at length for five or six hours was made as strong and intense as the furnace (which was not bad) was capable of giving (which violence of fire is a circumstance not to be omitted in the operation). By this means there came over good store of white fumes, almost like those that appear in the distillation of oyl of vitriol; and when those fumes are passed and the receiver grew clear, they were after a while succeeded by another sort, that seemed in the receiver to give a faint, blewish light, almost like that of little burning matches dipped in sulphur. And, last of all, the fire being very vehement, there passed over another substance that was judg'd more ponderous than the former, because it fell through the water to the bottom of the receiver, whence being taken out (and partly even whilst it stay'd there), it appeared by several effects and other phenomena to be such a kind of substance as we desired and expected."

Hanckwitz, the servant of Boyle, and working under his direction, at the laboratory in Southampton Street, London, succeeded, by his own skill, and perseverance, in considerably improving the process or manufacture, and produced phosphorus in larger quantities than any other person. He confirmed the opinion of his master, that it required an intense heat for its extraction; he

states, "for in truth and fact it is not a work for gentlemen and cabinet chymists, but there is required for it an operator well versed in fires, to whom its mechanick and manipulation is well known." In an advertisement he states:—"For the information of the curious, he is the only one in London who makes inflammable phosphorus which can be preserved in water. Phosphorus of Bolognian stone, flowers of phosphorus, black phosphorus, and that made with acid oil, and other varieties. All unadulterated; every description of good drugs. He sells wholesale and retail. N.B. He sells solid phosphorus, wholesale, fifty shillings an ounce, and retail, three pounds sterling the ounce."

In a "Historical Sketch of the Progress of Pharmacy in Great Britain, by Jacob Bell," it is stated, that "A house and shop, with a laboratory, were built on the Bedford estate, in the year 1706, by Ambrose Godfrey Hanckwitz, who had carried on business as a chymist in the neighbourhood since 1680. He was a maker of phosphorus and other chemicals, which were rare at that period, and which he sold in different parts of the country during his travels. His laboratory was a fashionable resort in the afternoon on certain occasions, when he performed popular experiments for the amusement of his friends. It opened with glass doors into a garden, which extended as far as the Strand, but which is now built upon. Four curious old prints of the laboratory in its former state are in the possession of its present proprietors, Messrs. Godfrey and Cooke, of Southampton Street, Covent Garden, also a portrait of Ambrose Godfrey Hanckwitz, engraved by George Vertue (1718), which he had distributed among his customers as a keepsake."

(To be continued.)

Products from the Combustion of Gunpowder under Different Pressures, by B. F. CRAIG.

THE perusal of the paper of Bunsen and Schiskoff on "The Chemical Theory of Gunpowder," whose publication about two years ago attracted much attention (*American Journal of Science and Arts* [2], xxvi. 106), led me, as it no doubt did others, to make some experiments on the residues of exploded powder.

The investigations of the above-named chemists were made on the products of gunpowder which had been burned in small quantities, and under very slight pressure, and, in concluding their paper, they advance the supposition that, under a difference of circumstances, the products may be essentially different from those which were obtained by themselves.

Such is actually the case, for the solution obtained by washing a gun with well-boiled distilled water, immediately after its discharge, and filtering while hot, will be found to contain sulphuret of potassium, with very small quantities of other substances, while Bunsen and Schiskoff found their residues to consist mainly of sulphate and carbonate of potash. This difference is what was to be expected from our knowledge of chemical laws; and it is also to be observed that the products of combustion in the gun vary somewhat according as the explosion takes place under a greater or less pressure. Thus, in firing with a shot very heavy in proportion to the charge of powder, as in firing a mortar, the washings of the piece are found to be of a bright green colour, while the ordinary washings of a gun are colourless after the suspended carbon has been allowed to settle, or has been removed by filtration.

The colour above spoken of is exactly the tint of a solution of a sesquisalt of chromium; it is not impaired by filtration of the liquid, but disappears in a few hours by exposure to the air, and immediately by the action of acids. The cause of this colour seemed to me at first obscure, but I found that by adding a very minute quantity of freshly precipitated sulphuret of iron to solution of protosulphuret of potassium, the same colour was produced, and a sensible trace of iron may always be found in gunpowder.

A greenish colour is frequently observed when sulphuret of iron is precipitated in the presence of an alkaline sulphuret, but as it disappears on standing, it has been commonly attributed to the presence of particles of sulphuret of iron held in suspension, an opinion which must be erroneous, since I have obtained a solution of iron in sulphuret of potassium of an intensely green colour, perfectly clear and transparent, and permanent for many days in a sealed tube,

Why this green compound should be formed under some circumstances, and not under others, in a mortar, and not in a cannon, is not insusceptible of explanation.

It has been shown that when powder is exploded under slight pressure the alkaline metal remains in large part as a sulphate, but under higher pressure, and corresponding temperature, it is reduced to the condition of a sulphuret. Now, by analogy, it would seem, that with the ordinary charges of a cannon or musket the iron is not reduced to the state of sulphuret, but if, as is often the case in a mortar, the projectile is fifty times the weight of the powder, or upwards, the gases are brought to a state of great tension before the shot moves, and in that state of things the carbon is completely converted into carbonic acid, and the iron, as well as the potassium, brought to the condition of sulphuret.—*American Journal of Science and Arts.*

On the Solidification of Carbonic Acid, by MM. A. LOIR *and* CH. DRION.

IN a paper read before the Academy, June 2, 1860, we stated that atmospheric pressure liquefies carbonic acid when its temperature is reduced to the point at which liquid ammonia evaporates *in vacuo*. By slightly modifying the conditions of the experiment, we have succeeded in solidifying carbonic acid with the aid of an apparatus as simple as those daily employed in chemical laboratories. This hitherto dangerous and costly operation may in future be easily repeated to a chemical class.

If liquid ammonia is introduced into a glass globe, and the interior of this put in communication with a good air-pump, by the intervention of a vessel containing coke impregnated with sulphuric acid, the temperature of the liquid is rapidly reduced from the first strokes of the piston. The liquid begins to solidify towards — 81°; it soon becomes a mass, and if the air-pump allows the reducing of the pressure to about a millimètre of mercury, the temperature of the solid ammonia becomes lowered some degrees more and reaches — 89·5.° This suffices to determine the liquefaction of carbonic acid under atmospheric pressure. We have, in fact, proved that carbonic gas liquefies by passing a current of the dry carbonic acid gas into a small U shaped tube, immersed in ammonia; but as the temperature obtained is only a few degrees below that of saturation, we get only a small quantity liquefied. If, on the contrary, a slight elevation of pressure is employed, the experiment becomes easy, and yields in a short time notable quan-

tities of solid carbonic acid. The following is the manner of operating:—Introduce about 150 cubic centimètres of liquid ammonia into a reversed glass receiver, the sides of which are cemented to a plate with two holes. In the central opening fit a glass tube, closed internally, and reaching the bottom of the receiver, the other opening serving to place the interior of the receiver in communication with the pneumatic machine. Carbonic acid is produced by heating previously-dried bicarbonate of soda in a copper retort, the neck containing fragments of chloride of calcium. One part of this retort communicates by a leaden tube on one hand with the tube which is immersed in liquid ammonia, on the other hand with a small manometer of compressed air. The air being previously expelled from the apparatus, and the temperature of the ammonia lowered to about the point of solidification, the retort is heated, noting meanwhile carefully the pressure. The pressure is thus maintained between three and four atmospheres. Rapidly augmenting transparent crystals soon appear on the sides of the interior tube, so that in about half-an-hour all that portion of the tube which is plunged in ammonia becomes covered with a thick stratum of crystals (about 25 grammes). The experiment may then be concluded and the apparatus dismounted.

Solid carbonic acid, obtained under the above mentioned conditions, appears a colourless mass as transparent as ice. It is easily detached from the sides of the condensing-tube by means of a glass rod; it then divides into large cubic crystals, each side about three to four millimètres. Exposed to the air, these crystals slowly return to their gaseous state; they evaporate, leaving no residue. Placed on the hand, they communicate no immediate sensation of heat or cold; they are with difficulty held in the fingers, and with a slight pressure escape as if covered with an unctuous matter. If one of these crystals is kept between the thumb and forefinger, it soon produces an intolerable burning.

An experiment was performed by placing a certain quantity of solid carbonic acid in a small glass tube communicating with a receiver filled with mercury. After some time the crystals disappeared, leaving no residue, while the receiver was filled with perfectly pure carbonic gas, capable of being completely absorbed by potash. Mixed with ether, in a small porcelain crucible, these carbonic acid crystals yield a freezing mixture of a temperature of — 81°.

As a conclusion to these summary indications we will add that the liquid ammonia used in our experiments was prepared by M. Bussy's process,—that is to say, by acting on ammoniacal gas in a globe surrounded with liquid sulphurous acid, the evaporation of which is expedited by an air-pump. By this method nearly two decilitres of liquid ammonia can be easily obtained in less than two hours.

We determined the temperatures here indicated by means of an alcoholic thermometer, on which we marked two fixed points,—that is to say, 0° at melting ice, and — 40° at the temperature of melting mercury.—*Comptes-Rendus.*

On a Black Varnish for Zinc, by M. Bœttger.

M. Bœttger describes a process for covering zinc with a chemical, adherent velvet-black varnish. Dissolve 2 parts by weight of nitrate of copper and 3 parts of crystallised chloride in 64 parts of distilled water; add 8 parts of hydrochloric acid of 1·10 density; into this liquid plunge the zinc, previously scoured with fine sand; then wash the metal with water and dry it rapidly.

This coating constitutes a kind of metallic alloy. It is M. Bœttger's opinion, that characters in relief may be executed on a sheet of zinc by using this composition, and by employing dilute nitric acid (1 to 10), as the black coating resists the acid which attacks only the unpreserved metal.—*Journal de Pharmacie et de Chemie.*

Influence of Lithia on Fructification, by M. De Salm-Horstmar.

Barley does not develope itself in coarsely-powdered and washed rock crystal; after being watered with water containing carbonate of lime, magnesia and manganese, sulphates, phosphates, and fluoride of potassium, it sent forth a feeble shoot but did not fructify; but by the addition of a trace of nitrate of lithia (a hundredth of a milligramme!) a barley corn flowered, and yielded two perfectly ripe grains.

From this experiment the author insists that lithia is indispensable to the development of grain.—*Annal. der Physik und Chem.*, vol. cxi. p. 644.

PHARMACY, TOXICOLOGY, &c.

On Arsenic-Eating in Styria.

Professor E. Schafer, of Gratz, publishes (*Sitzungsber. der Akad. der Wissenschaft zu Wien*) a few more particulars respecting the arsenic eaters of Styria. The paper seems to be the same as that quoted by Dr. Roscoe (Chemical News, vol. ii. p. 261), but contains some particulars which were omitted from our report. At the new moon, it should seem, the use of arsenic is for a time suspended, and then begun again with the smallest dose, which is increased from day to day until the moon reaches the full. The dose is then gradually diminished again, and a dose of aloes is taken occasionally, until strong purging is produced.

Most arsenic eaters observe no peculiarity in their diet, but some avoid fatty food, and the greater number are given to the free use of spirituous liquors. There are some differences of statement as to the form in which the arsenic is taken. In some cases powdered white arsenic is said to be swallowed "in a warm liquid, such as coffee" (Chemical News, vol. i. p. 281); but in the case observed by Dr. Knappe, and quoted by Dr. Roscoe, the man took a piece of solid arsenic, crunched it with his teeth, and swallowed it. The urine of this man contained but a trace of the poison, and therefore it is reasonable to suppose that when arsenic is taken in a solid form, on account of its insolubility, the greater part is carried away in the fæces.

In the case of a horse, experimented upon by Dr. Koch, arsenic was found in the saliva, blood, urine, and excrement, the largest proportion necessarily in the last. The experiments of Dr. Koch show that the elimination of arsenic by the urine takes place very slowly, and that the poison accumulates in the blood.

On an Improved Method of Preparing Sodæ Carbonas Siccata, by Harry Napier Draper, *F.C.S.L.*

The directions of the three British Pharmacopœias for the preparation of dried carbonate of soda are in almost every respect alike. Crystals of carbonate of soda are

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exposed to the action of heat until the whole of their water is dispelled. This process has two disadvantages: 1. The carbonate of soda of commerce, which is always used in practice to the exclusion of the pure product of the Pharmacopœias, invariably contains sulphates and chlorides. These are, of course, found also in the dry salt. 2. The hard cake which results from the desiccation of the crystals is extremely difficult to powder, and never makes a really elegant preparation.

Both these inconveniences may be remedied by the substitution of bicarbonate of soda for the carbonate. When this salt is heated to redness it, as is well known, loses one of its two equivalents of carbonic acid and all its water, a pure mono-carbonate remaining. Bicarbonate of soda of commerce is nearly always almost pure, never, as far as my experience goes, containing more than slight traces of chlorides and sulphates. When not heated beyond redness, the resulting carbonate is not hard, but, on the contrary, is a loosely cohering perfectly white powder. The slight difference in the cost of carbonate and bicarbonate is of small moment when compared with the saving of time and trouble, and the superiority of the dried carbonate made from the latter salt.—*Dublin Medical Press.*

PHYSICAL SCIENCE.

On the Boiling-points of Liquids, by M. L. Dufour, *of Lausanne.*

It is an established fact that the temperature of boiling water, instead of being always the same, or varying only with the atmospheric pressure, differs according to the vessel in which the liquid is heated. For instance, water boils sooner in a metal than in a glass vessel, and M. F. Marcet's numerous experiments (*Bibliothèque Universelle*, vol. xxxviii. p. 381) have shown, amongst other things, that the treatment a glass vessel has undergone (as washing in sulphuric acid, &c.) causes several degrees of variation in the boiling point. Water deprived of the air dissolved in it can be re-heated considerably above 100° C. before becoming gaseous, but then it boils violently. Donny, in his interesting experiments (*Annales de Chimie, et de Physique*, third series, vol. xvi. p. 167), carefully heated water completely freed from air, to 135° before a change of condition took place. This retardation of ebullition is manifested also by other liquids, and the production of vapours by starts is a frequent sign of it in glass vessels.

In the actual state of things, boiling produced at a higher temperature than that at which the elastic force of the vapour of the liquid is equal to the external pressure is generally considered as an anomaly due to two causes,—firstly, the adhesion of the liquid to the substance of the vessel; secondly, the absence of air in solution. There are, however, some curious facts, which show that the adhesion of a solid and the absence of air in solution are inadequate to explain the retardation in boiling; but, on the contrary, contact with a solid produces an immediate and decided formation of vapours. If a few drops of water are dropped into linseed oil, heated to 105° or 110° in a porcelain capsule, they fall slowly to the bottom of the vessel. The instant they reach it vapour is formed suddenly; the slightly-diminished drop of water rebounds several millimètres from the bottom, then falls again, causing another disengagement of vapour; again it rises, and so on. Now, it must be remarked that the drops of water, while floating in the oil, before touching the bottom of the vessel, undergo no perceptible evaporation, and that it is only on their contact with a solid that there is a sudden production of a bubble of vapour.

It will, then, be asked, What would happen were the water while being heated, kept away from the sides of the vessel, floating freely in a medium of a density equal to its own? The proper medium to be employed in these experiments ought to be able to bear temperatures above 100° without boiling, to be about the same density as water, and not to mix with water. Oils will not do, but certain essences sufficiently fulfil these conditions.

Essence of cloves, with a little oil added, forms a liquid in which water maintains its equilibrium in perfectly rounded drops, and moving about freely in the interior. Carefully heated, the mixture always passes 100° C, and sometimes goes much higher before the water boils. It is easily and constantly raised to 120°, 130°, and even higher. I have many times raised the temperature of aqueous globules of ten millimètres in diameter, to 140° and 150°. Minute globules, from one to two millimètres in diameter, have several times reached 170°, and even 175°,—that is to say, to temperatures at which the elastic force of aqueous vapour is more than eight atmospheres. I am speaking here of water which has undergone no preparation, which has been neither distilled nor freed from air. At these high temperatures the globules do not undergo, as might be imagined, slow and continuous ebullition; they are as quiet and limpid at 150° as at 10°; it is rather the liquid state continued much beyond the limits corresponding to the psessure under which the operation is performed.

Ebullition is produced when the globules come in contact with a solid. If, drawn by the currents, which heating inevitably occasions, they strike against the sides of the vessel or the bulb of the thermometer, there is suddenly formed a bubble of vapour; the globule, become rather smaller, is projected violently from the point at which it produced this kind of explosion, and then continues floating in the medium. The result is the same if, when the temperature is above 115° or 120°, a globule is touched with a glass or metal rod; an explosion is produced at the point of contact, a bubble of vapour is disengaged and passes through the essence, and the globule touched rebounds as though the solid point exercised a sudden repulsion over it. However, all solids are not equally efficacious in producing this change of state; glass or metal rods sometimes fail, but a slender wooden or charcoal stick always incites an immediate and tumultuous ebullition in the middle of the overheated globules. Contact with saline crystals is generally very efficacious.

It is difficult to preserve large globules from contact with the sides; hence they are the seat of the formation of vapour on one point of their surface, which has the effect generally of breaking them up into smaller globules. In my experiments, the vessels employed were small glass globes, and I have already easily obtained a globule of eighteen millimètres, at 130° C., and others of six to ten millimètres at 150° C., &c. The smallest globules most readily escape contact with the sides, and can be submitted to a higher temperature.

It may well be supposed that the preceding facts may be realised with other liquids if heated under proper conditions. This supposition is confirmed by the experiments I am now making. For instance, chloroform, heated in a concentrated solution of chloride of zinc,

easily reaches 90° and 100°. The chloroform globules float lightly in this liquid, like water globules in essence of clove. Beyond 70° contact with a solid rod produces decided and violent evaporation.

It is difficult not to connect these facts with those in which contact with a solid causes the crystallisation of super saturated saline solutions, and also the sudden solidification of water, sulphur, &c., when brought below their ordinary temperature for solidifying. It is equally difficult to disconnect them from the facts which I have lately had the honour to bring before the Academy,—facts which showed that liquids resist solidification when immersed in a fluid medium. It appears that contact with a solid determines a change of state in liquids, and it may be that the limits of temperature assigned to the various conditions of bodies are not so absolute as they seem. Our experiments on liquids always made in vessels in contact with solid bodies may perhaps have led us wrongly to consider, as inherent properties of the liquids themselves, the phenomena resulting, at least in part, from the presence of solids. Thus, when water floats freely in a fluid it rarely freezes at 0°, and it is only changed into vapour at a point of the thermometric scale always exceeding 100°.—*Comptes Rendus.*

Researches on the Chemical Action of the Spark from Ruhmkorff's Induction Apparatus, by M. ADOLPHE PERROT.

THE following results have been obtained by the author in a lengthened examination of the chemical action of the spark of Ruhmkorff's induction apparatus. The complete paper appears in the *Annales de Chimie et de Physique*, series 3, vol. lxi. pp. 161—199.

1. Discharges by the direct current from Ruhmkorff's apparatus decompose aqueous vapour.

2. Induction sparks combine or decompose gases or vapours more energetically than sparks from an electrical machine.

3. The intervention of a condenser in the induced circuit increases the intensity of the chemical action of the spark; but as the condenser diminishes at the same time the length and number of the discharges, it should be employed only when the ordinary spark is insufficient to produce the desired combination or decomposition.

4. A portion of the aqueous vapour decomposed by the discharge of the direct induction current undergoes electrical decomposition.

5. The quantity of gas or vapour combined or decomposed by the induction spark increases with the length of this spark, the intensity of the current remaining unchanged. In other words, the longer the spark with the same direct current, the more gas or vapour it combines or decomposes.

6. With a given induction apparatus, as well as induction current, there exists a length of spark corresponding to the maximum of chemical action.

The use of currents of gas or vapour offers great advantages in all processes relating to the chemical action of sparks. In this manner he has obtained as much as three litres of gas hourly by decomposing alcohol, ether, or acetic acid vapour. A current of carbonic acid, submitted to the action of an induction spark, gives a mixture of oxide of carbon and oxygen which in less than an hour increased in volume to 200 cubic centimètres. The decomposition of ammoniacal gas is still more energetic.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 6, 1861.

Dr. HOFMANN, *President, in the Chair.*

MR. A. W. LENNOX read a paper *On Bromide of Carbon.* This body, C_2Br_4, heretofore obtained by the action of bromine upon alcohol or ether, was prepared by the author from olefiant gas by a succession of alternate treatments with bromine and alcoholic solution of potash, precisely as chloride of carbon is usually prepared. It was deposited from its alcoholic solution in beautiful crystalline plates, having an aromatic odour. It fused at 50° C., and sublimed at a higher temperature.

Dr. DAUBENY read a paper *On the Power Ascribed to the Roots of Plants of Rejecting Poisons or other Abnormal Substances Presented to them.* The author considered that the composition of the ash of any plant varied only within certain limits when grown in very different soils; although, indeed, a small variation in the relative proportions of potash and soda, and of lime and magnesia, might be found according as these ingredients were more or less abundantly supplied. But he contended that these variations had reference, not to the mineral matters associated essentially with the different tissues of the plants, but to the mineral matter of the fluids circulating through the vegetable organism. He inferred that the spongioles of the roots had residing in them a specific power of excluding those constituents of the soil which were abnormal and therefore inimical to the plant, but that they took up those which were normal in any proportion in which they chanced to present themselves, the redundant portions, however, left after the necessities of the organism had been provided for, being again excreted, so that a vegetable will only vary in mineral composition, in proportion to the relative amounts of the several proximate principles produced under the peculiar circumstances of its cultivation. He doubted whether poisons were ever taken up by the living roots of plants, although, when the vitality of the roots was destroyed by the action of a poison, some portion of it might enter the plant by physical imbibition. His experiments were made principally with barium and strontium salts, and with white arsenic.

The PRESIDENT: I am sure we must all feel extremely obliged to Dr. Daubeny for the very elaborate paper in which he so lucidly treats a subject equally interesting on account of its purely scientific bearings, and on account of its importance for the purposes of agriculture. I see several gentlemen here who have paid particular attention to this question, and hope they will favour the meeting with any remarks which their experiments upon this subject may suggest.

Dr. GILBERT: There are one or two points to which I should like to refer. I quite agree with Dr. Daubeny that there is not, so far as facts would show, anything like a substitution of potash by soda in the way originally supposed. We find that there is a great difference in the composition of the ashes of vegetable substances, so long as they are green and unripe; and even within certain limits—but the limits are very distinct—we find a variation according to the condition of the soil; but the nearer we approach to the maturity of any one organ, the more distinctly is a definite composition visible. And this is even observable in comparing one professedly ripened product with another. For instance, we take wheat grain ripened in good seasons and in bad seasons, and we find in the ashes of that ripened in the bad season, a very much larger proportion of soda than in those of the grain ripened in the good season; and you will find in one season a very much larger quantity of starch, and in

another a very much larger proportion of nitrogenous substances, sometimes not in a perfectly ripe condition; and according to those circumstances we do find a certain variation. But the farther the organ has advanced towards finality, and the more matured it is, the more exact and permanent is the composition. I perfectly agree with Dr. Daubeny in the explanation which he gives of the occurrence of what may be called abnormal matters, at least, extraneous matters in professedly ripened substances; that is to say, it is to be accounted for by the fact that the substances are not really ripened and we have a large proportion of the proximate principles. This subject Mr. Lawes and myself went into considerably some time ago,—I think in 1847,—and we have also advocated this view in a paper before this Society. With regard to the question of the condition in which plants take up their food, I am disposed to think we really do not know very much about it, but at any rate it is not, I think, essential from the facts to conclude that they do not take it up absolutely in solution, but plants undoubtedly give off water during their growth. In relation to the substances which they fix we account for their taking up of almost insoluble substances; and what is more, I have seen plants grow to perfect ripeness in perfectly clear solutions, without ever having been in connection with any solid matter; so that at any rate they can grow and mature from solutions. With regard to the question of the taking up of poisons, I have observed that some of the evidence which Dr. Daubeny has quoted is already published in regard to that subject; but there are also some results of a gentleman, who is I believe a Fellow of this Society, also published in answer to those of Dr. Davy, in which he could not get any plants to grow which he manured with arsenical solutions. In the year 1843 we manured a large quantity of wheat with arsenical solutions, and a very large proportion of the plants died; but what did grow we very carefully took care of in the field, but unfortunately it was lost by other means; otherwise it was our intention to feed poultry with the grain, and observe the effect upon them, and also examine whether we got anything in the bones of the animal.

Dr. Marcet: Perhaps, Mr. President, you will allow me an observation upon this interesting paper, which I have listened to with very great attention and interest. From the many experiments which Dr. Daubeny has stated to-night, and among them those of Lindley, may it not be that the arsenic, used in Dr. Daubeny's inquiry, mixed with soil containing manure, and this soil being in a fit state for growing plants, enters into some peculiar chemical combination which neutralizes more or less its poisonous properties, at the same time enabling its rapid elimination from the plants growing on the soil in question; and that, in fact, the poison is not rejected by the roots, but absorbed and then excreted? If we consider the great analogy between vegetable and animal life, this elective property of roots will be difficult to conceive; for in animals every substance which the stomach and intestines contain in a state of solution, is absorbed within certain limits, regulated by the laws of endosmosis. On the other hand, we are acquainted with poisons which under certain chemical conditions lose much of their power; as, for example, mercury, a substance tolerated much better under some forms than under others; indeed, the virulence of a poison appears to be diminished if exhibited in a state which will effect its rapid elimination from the body. Such is probably, for instance, the iodide of mercury. These observations have only just occurred to me, and are offered with due regard to Dr. Daubeny's interesting views.

Dr. Daubeny: I would remark, Mr. President, that Dr. Marcet's view would require that we should be able to detect poison in the plant. If we could find arsenic in the plant, then I admit the fact; but it appears to be very doubtful from my experiments whether the arsenic does find its way into the interior of the plants. The few instances in which I have detected it, seem to be very well explained by the adherence of some small particles of the substance to the exterior; and therefore the inference I have drawn is, that it is not absorbed by the roots. The same remark applies to strontium, which is not poisonous to plants.

Dr. Odling: A year or two ago, I was called upon to examine into the causes of the death of some cattle at Swansea. On examination, I found arsenic was the cause of death. The soil of the place on which they were fed was very rich in arsenic, and the animals had taken some of this arsenic into their bodies. The grass was also found to contain arsenic. I then sent for some turnips grown in the soil, but I could not detect any arsenic whatever in the tissues of the turnips. Then I had some of the soil which contained several grains of arsenic in the pound, and we grew some radishes in it, but we could not find any arsenic in them. The arsenic was in a very insoluble state. There seemed to be a great amount of copper slag; but I suppose the iron in a soil is quite sufficient to render any ordinary amount of arsenic insoluble in water. These results, then, seem to corroborate the results obtained by Dr. Daubeny. I read Dr. Davy's experiments at the time they appeared, and I thought them fallacious. There was no doubt about arsenic being present in this case, because there is a large quantity of pyrites in the shale. The shales which are in the coal mines in the district of Swansea, are very well adapted for growing potatoes. It is a well known fact that in Merthyr and Swansea they grow excellent potatoes.

The President: In the interest of the Chemical Society I hope that Dr. Daubeny will favour us with the result of the new researches which he proposes to undertake upon this important subject, as soon as they are completed.

The President then said, that there being no other paper before the Society that evening, he would beg leave to communicate verbally to the meeting some results he had lately obtained in studying the *Decomposition of Cyanurate of Ethyl*. Cyanate and cyanurate of ethyl, as is well known, when distilled with the hydrated alkalies are decomposed, carbonic acid and ethylamine being produced, thus,—

$$C_2H_5\,CNO + \left.\begin{matrix}H\\H\end{matrix}\right\} O = CO_2 + (C_2H_5)\,H_2N$$

$$(C_2H_5)_3\,C_3N_3O_3 + 3\left.\begin{matrix}H\\H\end{matrix}\right\} O = 3\,CO_2 + 3\left[(C_2H_5)\,H_2N\right]$$

but if, instead of submitting the cyanate or cyanurate of ethyl suddenly to the action of the alkali, the two bodies be allowed to act gradually upon one another, the production of ethylamine is preceded by the formation of several intermediate bodies.

Dr. Hofmann stated that when cyanate of ethyl is allowed to flow drop by drop into a retort containing ethylate of sodium, a powerful evolution of heat takes place, and a portion of the cyanate distils over; but the larger portion is converted into the cyanurate, which may be obtained by treating the mass left in the retort with hot water and crystallizing. If the mixture of ethylate of sodium and cyanurate of ethyl be heated, the temperature being gradually raised, a large quantity of ethylene gas is evolved, and an alkaline liquid distils over containing alcohol, an oily compound soluble in alcohol, difficultly soluble in water, ethylamine and a basic oil with a very high boiling point, which is partially decomposed by distillation. The basic oil forms with acids a series of salts, of which the iodide, the platinum- and gold-salts are the finest. The analysis of the two latter compounds gave the following formulæ:—

$$C_7H_{17}N_3,\,H\,Cl,\,Pt\,Cl_2.$$
$$C_7H_{17}N_3,\,H\,Cl,\,Au\,Cl_3.$$

The free base, when liberated from its compounds, retains one equivalent of water, which it holds with considerable force, forming a hydrate of the formula,—

$$C_7 H_{19} N_3 O = C_7 H_{17} N_3, H_2 O.$$

The action which takes place on distilling ethylate of sodium with cyanuric ether is very simple; the change is produced by the gradual action of the hydrate of sodium, which is formed by the decomposition of the ethylate, on the cyanurate of ethyl, thus,—

$$\underbrace{C_9 H_{15} N_3 O_3}_{\text{Cyanuric ether.}} + 4\left\{\begin{matrix}Na\\H\end{matrix}\right\} O = 2\left\{\begin{matrix}Na\\Na\end{matrix}\right\} CO_3 + \underbrace{C_7 H_{17} N_3, H_2 O}_{\text{New base.}}$$

Dr. Hofmann pointed out that this base is the term in the ethyl-series corresponding to a body in the phenyl-series which he had produced some time ago by the action of tetrachloride of carbon on aniline. The phenylic compound may be referred either to two or to three molecules of ammonia, when it becomes cyantriphenyliamine or carbotriphenyltriamine respectively, thus,—

$$C_{19} H_{17} N_3 = (CN)(C_6 H_5)_3 H_2\Big\} N_2 = C^{iv}(C_6 H_5)_3 H_2\Big\} N_3$$

In a similar mannner the ethylated body also may be referred to two or to three molecules of ammonia.

$$C_7 H_{17} N_3 = (CN)(C_2 H_5)_3 H_2\Big\} N_2 = C^{iv}(C_2 H_5)_3 H_2\Big\} N_3$$

The formulæ representing these bodies as triamines, indicate in some measure the manner in which the three molecules of ammonia are linked together in these compounds. They are also in accordance with the production of the phenyl term by the action of tetrachloride of carbon on aniline.

The base methyluramine, discovered by Dessaignes among the products of the oxidation of creatine, and guanidine, the substance lately obtained by Strecker by the action of oxidizing agents on guanidine,—belong to the same group of bodies. If these substances are referred to three molecules of ammonia, they can be expressed by the formulæ,—

Carbotriamine (Guanidine)	$C^{iv}H_5$	$\}N_3$
Methylcarbotriamine (Methyluramine)	$C^{iv}(CH_3)H_4$	$\}N_3$
Diphenylcarbotriamine (Melaniline)	$C^{iv}(C_6H_5)_2H_3$	$\}N_3$
Triphenylcarbotriamine	$C^{iv}(C_6H_5)_3$	$\}N_3$
Triethylcarbotriamine	$C^{iv}(C_2H_5)_3H_2$	$\}N_3$

The most perfect parallelism existing between the products of decomposition of these bodies clearly indicates their great analogy to one another.

Guanidine treated with nitric acid gives ammonia and urea

$$CH_5N_3, H_2O = H_3N + CH_4N_2O.$$

The ethylated base by distillation forms ethylamine and diethylurea

$$CH_2(C_2H_5)_3N_3H_2O = (C_2H_5)H_2N + CH_2(C_2H_5)_2N_2O.$$

Habich and Limpricht have discovered that an indifferent body is produced when cyanurate of ethyl is treated with hydrate of potassium; this body obviously stands midway between the new base and cyanuric ether; the latter therefore passes through two stages before being transformed into ethylamine, the action consisting in the successive assimilation of water, the carbon of the cyanuric acid being gradually eliminated as carbonic anhydride.

$$\underbrace{C_3(C_2H_5)_3N_3O_3}_{\text{Cyanuric ether.}} + H_2O = CO_2 + \underbrace{C_2H_2(C_2H_5)_3N_3O_2}_{\text{Indifferent body.}}$$

$$\underbrace{C_2H_2(C_2H_5)_3N_3O_2}_{\text{Indifferent body.}} + H_2O = CO_2 + \underbrace{CH_4(C_2H_5)_3N_3O}_{\text{New base.}}$$

$$\underbrace{CH_4(C_2H_5)_3N_3O}_{\text{New base.}} + H_2O = CO_2 + 3\underbrace{[(C_2H_5)H_2N]}_{\text{Ethylamine.}}$$

Cyanuric acid, when transformed into carbonic anhydride and ammonia, must evidently undergo a precisely analogous series of changes, intermediate bodies being produced. These bodies are known, but have not as yet been obtained from cyanuric acid. A substance described by Wiedemann as *biuret* is one of these intermediate bodies, and *guanidine* is the other.

Cyanuric acid	$C_3H_3N_3O_3$
Biuret	$C_2H_5N_3O_2$
Guanidine.	$C H_7N_3O$

and by proper methods we may probably succeed in arresting the decomposition of cyanuric acid at the intermediate stages.

In conclusion, Dr. Hofmann pointed out that even now the cyanogen group is rich in examples of these gradual transformations. Liebig's researches on melamine have shown that this substance is converted by assimilation of water and separation of ammonia into ammeline, ammelide, and cyanuric acid, and as before stated, cyanuric acid may be transformed by assimilation of water and separation of carbonic anhydride, instead of ammonia, into biuret, guanidine, and ammonia.

The following equation shows the ultimate product of the action of alkalies upon melamine:—

$$C_3H_6N_6 + 6H_2O = 3CO_2 + 6H_3N.$$

But this assimilation of water takes place molecule after molecule, not less than five intermediate compounds being produced as is illustrated by the following symmetrical equations:—

Melamine	$C_3H_6N_6 + H_2O =$	$H_3N +$	$C_3H_5N_5O$	Ammeline
Ammeline	$C_3H_5N_5O + H_2O =$	$H_3N +$	$C_3H_4N_4O_2$	Ammelide
Ammelide	$C_3H_4N_4O_2 + H_2O =$	$H_3N +$	$C_3H_3N_3O_3$	Cyanuric acid
Cyanuric acid	$C_3H_3N_3O_3 + H_2O =$	$CO_2 +$	$C_2H_5N_3O_2$	Biuret
Biuret	$C_2H_5N_3O_2 + H_2O =$	$CO_2 +$	$C H_7N_3O$	Guanidine
Guanidine	$C H_7N_3O + H_2O =$	$CO_2 +$	H_9N_3	Ammonia.

Dr. Williamson: I may, perhaps, be permitted to draw attention to one circumstance connected with the starting point of Dr. Hofmann's remarks, I mean the reaction of hydrate of potash upon cyanic ether, which I think is not unimportant in this consideration of the transformation—I mean the question of what really happens—of whether it is a replacement of carbon for hydrogen or not. I must say that, in my own opinion the reaction, if you take in the whole process, cannot be represented as being an interchange of carbon and hydrogen. I think it is of necessity carbonic oxide, or the radicle that is combined in the carbonate, that interchanges with the hydrogen. Perhaps I may be permitted to show on the board what I mean. We will take as the starting point the formula of cyanic ether, which I will write as derived from the type of ammonia, in which one hydrogen is replaced by carbonic oxide, $C_2H_5\,CO\,N$. When we bring this in contact with hydrate of potash, we must take, in order to represent the reaction, at least two atoms of hydrate of potash,

$$\begin{matrix}H_2\\K_2\end{matrix} O_2 \text{ forming } \begin{matrix}CO\\K_2\end{matrix} O_2 \text{ and } C_2H_5H_2N,$$

and we have then an interchange of carbon and oxygen from the one group with hydrogen from the other. I will write it out in the form of an equation so that there may be no doubt. In this reaction there can be no possible doubt that what takes place is an interchange of hydrogen and carbonic oxide. Now, a partial decompo-

sition of the same kind takes place in the formation of the remarkable body mentioned by the President, $(C_2H_5)_3 H_4CON_3$. I say the same interchange takes place, and that precisely the same formula must be used, if you take into account the two products formed. I will write the formula of cyanuric ether. Twice this quantity of hydrate of potash, in four atoms, and replace the H_4 in them by two atoms of carbonic oxide, and get two atoms of carbonate of potash,

$$(C_2H_5)_3 (CO)_3 N_3 + \frac{H_4}{K_4} O_4 = 2\left[\frac{CO}{K_2} O_2\right] + (C_2H_5)_3 H_4 CO N_3$$

and the H_4 by taking the place of $(CO)_2$ in the cyanuric ether give rise to the body $(C_2H_5)_3 CO H_4N_3$ $(C_2H_5)_3 N_3CO$.

The President: I am much obliged to Dr. Williamson for his remarks, and may state at once that I have no objection whatever to his views regarding the action of the caustic alkalies upon the cyanic ethers. I have only one observation to make. The new bases which I have described contain their oxygen in the form of water, which is separated when they are converted into saline compounds. These saline compounds contain no oxygen. Moreover, several of the bases, *e.g.*, the carbotriphenyltriamine,

$$C'' (C_6 H_5)_3 N_3,$$

are known in the anhydrous condition. Whatever may be the reaction by which the formation of these bodies is accomplished, it is impossible to assume carbonic oxide either in the anhydrous bases or in their saline compounds. Probably the rapid sketch which I have endeavoured to delineate of these new bases did not set forth, in a sufficiently forcible manner, the anhydrous condition of their saline compounds. One more remark regarding the substitution of carbon for hydrogen. I do not wish in any way to press this view in an undue manner. I have already pointed out that these substances may be represented as cyanogen compounds. There are, in fact, some points which favour this mode of viewing them. Melaniline is formed by the action of chloride of cyanogen upon aniline, and may, therefore, with perfect propriety, be considered as diphenylcyandiamine.

$$(C_6H_5)_2 (CN) H_3] N_2.$$

There are at present no data at our disposal by which this question could be settled either way.

Dr. Williamson: My remark was only with reference to the body you described yourself, Sir, as containing oxygen. Of course, I did not allude to the product of decomposition from which oxygen is removed as water. I know no other view of the formation of the interesting body you have mentioned to us than that which represents it as effected by the interchange of carbonic oxide for hydrogen.

The President: I repeat, I have no objection to the view which you take regarding the form of the decomposition, but cannot accept your view of the constitution of the bases themselves.

Dr. Odling: I understand you to say, Dr. Hofmann, that by simply acting upon the body which Dr. Williamson has written, the hydrochloric acid turns out the water, and that by the addition of a hydrate you would there get back the original body. They thus differ from one another, as chloride of potassium differs from hydrate of potash.

The President: They do.

NOTICES OF BOOKS.

Report on the Presence of Bisulphide of Carbon in Gas, addressed to Robert Jones, Esq., Engineer to the Commercial Gas Company. By Fred. Versmann, F.C.S. London: 1861.

In the early part of last year the battle of the Metropolitan Gas Regulation Bill was being fought in a committee-room of the House of Commons. Among the points then hotly contested—so hotly, indeed, that the barristers engaged for the Companies withdrew from the field, and left the agents to fight out the case by themselves—was the quantity of sulphur which was usually present, or which might be allowed to be present in gas, without detriment to the consumers or disadvantage to the Companies.

It was about the same time that the Commercial Gas Company employed Mr. Versmann to make some determination of the amount of sulphur in their gas. That gentleman accordingly made a series of experiments *at the Works of the Company*, and the results which he obtained, together with the inferences he drew and the speculations he indulged in, are contained in the Report now under review. But before we refer more particularly to this Report, it will be as well to notice briefly what had previously been said on the subject.

Sulphur is admitted on all hands to be a most pernicious ingredient in gas. It is also conceded that it is possible to make gas which shall contain a very small amount in the form of bisulphide of carbon, while it has been found perfectly easy to remove every trace of that which existed as sulphuretted hydrogen.

The amount of sulphur in gas has been variously estimated by different experimenters. Mr. Lewis Thompson, who was considered a great authority on gas chemistry, has said that the amount of vapour of bisulphide of carbon in gas is seldom less than $\frac{1}{1000}$th of its bulk, which will correspond to about 119 grains of sulphur in 100 cubic feet. No other chemist has ever, that we are aware of, found so large an amount as this; but it seems probable that other estimates may have been as much below as Mr. Thompson's might have been above the actual amount.

On the part of the companies it has been sometimes said that sulphur in gas is a "myth," and the damage done by it a delusion. Of the mischievous results, however, there can be no doubt. One of the first things which drew public attention to the matter was the damage done to the books in the library of the Athenæum Club. Many of our readers will, doubtless, remember the discussion on the subject, in which the most celebrated English chemists of the day were engaged. Their investigations left no doubt that the injury done to the binding of the books was owing to sulphuric acid formed by the oxidation of the sulphurous acid generated in the combustion of the gas. Other libraries have since suffered to an equal degree, as our readers may see by referring to Dr. Letheby's Report, "On the Coal-Gas Supplied to the City of London, 1854," and beyond this there is not a silversmith, hardware-dealer, or draper, whose shop is lighted with gas, but has his own tale of the damage done to his goods by sulphurous vapours. Mr. J. E. Clift, the proprietor of the Redditch Gas Works, indeed, told the Committee of the House of Commons, that it was found impossible to use gas containing sulphur in some departments of the needle factories, so injurious was it found to be. It was natural then that an Act of Parliament, professedly designed to regulate the quality of gas, should fix on some limit which the quantity of sulphur was not to exceed. Dr. Letheby in his evidence, we believe, said, that the largest quantity he had ever found was 20 grains in a 100 cubic feet, and this was the limit fixed upon. But at one of the last sittings of the Committee (July 18) Mr. Baxter on behalf of the Companies, of whom, we presume, the Commercial was one, said that gas engineers admitted that if the "*twenty* grains were made *forty* it would do." The Directors of the Commercial Company, we may suppose, had Mr. Versmann's Report in their hands at this time, and we may now quote his results:—

Series of Experiments made at the Works of the Commercial Gas Company.

Commencement of Experiment.	Cubic feet of gas burnt.	Grains of $BaOSO_3$ obtained.	Grains of sulphur in 100 cub. ft. of gas.	Mean of grs. of S. in 100 cub. ft. of gas.
1860, Feb. 7	13	3·08	3·23	2·99
,, 28	30	6·80	3·12	
March 5	75	14·41	2·64	
,, 14	118	25·42	2·96	
May, 17	3·5	1·53	6·00	6·35
,, 21	2·0	0·98	6·70	

Now, we do not intend to question for one moment the perfect accuracy of the above results; but, coupling them with the fact above mentioned, they could not but excite astonishment in the mind of the most innocent person. Was it possible that the Companies knew much better than chemists how much sulphur their gas contained; or were they, when many complained of the badness of their gas, coolly asking permission to make it a great deal worse? Thinking that an independent examination might help us to a solution of these questions, and having the gas of the Commercial Company as supplied to their customers at command, we decided on making a series of determinations for ourselves. Our readers will see that our experiments were made at a distance of twelve months from those of Mr. Versmann; but as his report was written in June, 1860, and only issued this year, the inference is that the Directors wish it to be supposed that the gas Mr. Versmann examined is the gas they ordinarily supply.

The results of our experiments were as follows;—

Commencement of Experiment.	Cubic feet of gas burnt.	Grains of $BaOSO_3$ obtained.	Grains of sulphur in 100 cub. ft. of gas.	Mean of grs. of S. in 100 cub. ft. of gas.
1861, April 5....	25	108·7	59·56	57·38
,, 7....	25	113·8	62·34	
,, 9....	25	89·5	49·03	
,, 12....	25	115·1	63·07	
,, 22....	25	109·4	59·95	
,, 25....	25	91·9	50·36	

Our readers will probably share the astonishment we ourselves felt at the enormous discrepancy between our own results and those of Mr. Versmann. Well might the companies have asked for forty grains! Sixty, indeed, would hardly have been too much for them! That there might, however, be no mistake about the matter, we instituted another series of experiments, the results of which we condense.

Cubic feet of gas burnt.	Grains of $BaOSO_3$ found.	Grains of Sulphur in 100 Cubic Feet.		
		Minimum.	Maximum.	Average.
175	793·3	39·9	59·95	49·37

For reconciling the discrepancy between the results we obtained and those obtained by the Author of this Report, various hypotheses suggest themselves; but as our readers are probably as ingenious in guessing as ourselves, we need not further occupy our space with the matter.

Passing from Mr. Versmann's results to his inferences and speculations, we feel bound to characterise them at once as an elaborate mystification. "In proceeding," he says at starting, "to the practical view of the question, *i.e.*, whether this amount of sulphur" [*i.e., the amount which he obtained*] "may possibly become in any way injurious or obnoxious to persons inhaling the atmosphere of places where the gas is burnt, we must enter the dry field of calculation." Now, no one of credit—so far as we are aware—ever said that the sulphur was injurious to persons inhaling the atmosphere of places where gas is burnt. What has been said, and what has been proved over and over again, is that the sulphur products are injurious to metal work, to the delicate colours of various textile manufactures, to the binding of books, and to many other things. On the other hand, it has been said that the healthiness of London partly depends upon the disinfecting agency of the sulphurous acid in the atmosphere, no little of which is derived from the gas.

To show, however, that the sulphurous acid cannot possibly injure people, the Author goes on to calculate from his results what proportion by weight of sulphur is contained in a given weight of gas, and how much by weight and volume of sulphurous acid is formed by the combustion of a given quantity of the gas; and then proceeds to show that the burning of seven lucifer matches would give as much sulphurous acid as the combustion of 100 cubic feet of the worst gas he examined. We may dismiss this part of the subject with the remark, that our experiments show, that to arrive at an ordinarily correct result, Mr. Versmann's sulphur calculations must be multiplied by eight at least, and his lucifer matches be made fifty-six, the combustion of which in a room would indubitably give a suffocating odour to the atmosphere.

We need not follow the Author into his carbonic acid calculations, made with the view of showing the far greater danger to animal life from the amount this body formed during the combustion of the gas than from the sulphurous acid generated from the quantity of sulphur he found. *Cela va sans dire*, as our neighbours say. We may, however, express a qualified agreement with Mr. Versmann when he says: "I am of opinion, that before any person could be inconvenienced by these quantities of sulphurous acid, he must have ceased to live, long previously, from the effect of the carbonic acid." After that event we do not imagine the sulphurous acid in this world would inconvenience him at all; but it is easy to see what Mr. Versmann means if we put *would* for *must* in the foregoing sentence.

We have said enough to show the urgent necessity for the appointment of a Gas Examiner at the East end of the Metropolis, and now return for a moment to the Commercial Company. The Directors have just issued a circular to their customers, announcing that they have made arrangements for improving the quality of their gas to the standard of the Act of Parliament, and consequently intend to raise the price. How perfectly gratuitous! The Act allows 20 grains of sulphur in 100 cubic feet; and they publish a Report to show that the maximum amount contained in their gas is 6·7 grains, and then talk of improving the quality to the standard of the Act. Whether they do improve it or not, however, our readers will shortly learn.

There remains something to be said about the methods of estimating sulphur in gas, and the removal of bisulphide of carbon, to which we intend to recur in our next number.

NOTICES OF PATENTS.

Purification of Gas. F. J. EVANS and G. F. EVANS. (Not proceeded with.)

THE patentees propose to eliminate the sulphur compounds by admitting to the foul gas a small proportion of atmospheric air, or pure oxygen, and then passing the mixed gases over one of the following materials, heated to any temperature between 200 and 400 degrees Fahrenheit:—Coke, charcoal, asbestos, chalk, and asbestos coated with spongy platinum may be used for the purpose, and the heated purifier containing one of these substances is placed intermediate between the condenser and the ordinary purifier. The sulphur compounds become oxidised, and the sulphurous acid produced may be removed either by passing the gas through the crude ammoniacal liquor, or by adopting any of the ordinary processes of purification.

The problem involved in the foregoing specification seems to have been met by the suggestion, recently patented, of applying the hydrate of lime to effect the same purpose. When heated to the temperature indicated slaked lime appears to possess the property of converting all the sulphur compounds present in the impure gas into sulphuretted hydrogen, or such products at least as are capable of being removed subsequently by the ordinary lime purifiers. This method does not, moreover, render necessary the admixture of air, a proceeding which, if possible, it is certainly desirable to avoid.

Electric Telegraph Cables or Ropes. C. S. Duncan.

For the purpose of insulating the conducting wire or wires they are bound in a spiral manner with strips of cane which have been well tanned with oak bark, terra Japonica, or any known tanning agent. Raw silk may be used for binding on the strips of cane. The covered wire is then thinly coated with gutta-percha, india-rubber, or marine glue, or any mixture of these, and the interstices between the coils well filled up. This system of proceeding is repeated as often as desirable for the purpose of imparting strength to the wire, or of preserving it from external injury, and the admission of water. The cable thus built up is further covered with hemp, yarn, or wood shavings, and finally bound with strands of copper or other metallic wire, wire-rope, or rope composed simply of hemp.

Preserving Electric Telegraph Cables and Wires prior to their being laid. R. A. Glass. (Not proceeded with.)

The invention of Mr. Glass consists in packing the cables in air-tight boxes, or cases with double sides throughout, into the outer spaces of which may be introduced water, ice, or any cooling mixture. Or, further, the cables may themselves be immersed in water, and the tanks, which are now to be single cased, closed with tight covers, and the whole packed in a material being a non-conductor of heat.

Protecting and Insulating Subterranean Telegraph Wires. A. F. Jaloureau.

This patent refers to a process of insulating metallic wires by enclosing them within bitumenized paper tubes, or similar tubes made of any non-conducting material.

Purifying Oils and Varnishes. N. C. Szerelmey.

This specification refers to a mode of treatment for the clarifying of oils and varnishes by processes of filtration through certain porous media. In some cases the viscid character of the oil or varnish requires to be overcome by slightly warming prior to passing through the filter. This last recommendation might, in the case of some oils, sensibly depreciate their quality by rendering them more liable afterwards to become rancid; but this objection cannot possibly apply to varnishes which are themselves prepared at temperatures more elevated than that at which the process of filtration is intended to be conducted.

A New Mode of Obtaining an Article resembling Honey. C. Stevens. (A Communication.)

This invention consists in the production of a saccharine compound bearing a certain resemblance to honey, by the action of diastase upon any one of the ordinary varieties of starch. Whether derived from wheat, rice, or potato, the starch is mixed with about three times its weight of water, and a very small proportion of sprouted barley or infusion of malt then added. This latter ingredient acts the part of a ferment, and, at temperatures somewhat below 200 degrees Fahrenheit, induces the conversion of the starch into grape sugar, or more commonly into a mixture of dextrin and sugar. Such a product would undoubtedly possess a sweet flavour, but could scarcely, we think, be mistaken for ordinary honey.

An Improved Fuel. C. L. Hancock. (Not proceeded with.)

The inventor suggests the binding together of small coal or coal-dust with the help of water and lime as a cement. The mass resulting from the incorporation of these materials is to be formed into cakes or blocks, and dried either in the air or by exposure to a moderate degree of artificial heat. No great pressure is required in the formation of these blocks; and, although slaked lime is preferred by the inventor, he claims also the use of "compounds containing lime" (under which term are probably comprehended hydraulic limes, mortars, cements, &c.), for the purpose of agglutinating the coal particles, and of setting them into shaped masses.

As compared with any of the ordinary kinds of "patent fuel," the advantage of the *improved* mode of manufacture pointed out in the foregoing specification would appear to be very problematical. One of the first considerations taken into account in the selection of a fuel for all ordinary purposes is its comparative freedom from mineral impurities; for not only do these tend to impede the combustion of the fuel, but directly contribute to increase the proportion of ash left on burning. Small coal is often objected to, on account of its containing considerably more mineral matter than larger blocks from the same sample; and when it is proposed still further to add to the proportion of an objectionable ingredient, we might safely venture to predict the result of such a suggestion.

CORRESPONDENCE.

The Monohydrate of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—You did me the honour to report a verbal notice which I made to the Royal Society of Edinburgh of an experiment on sulphuric acid. It was stated, as the result of four experiments, made some years since, that the true monohydrate could be obtained by keeping it at a temperature about 50° below its boiling point. I have repeated these experiments lately, but cannot obtain the same result, the acid always being at least half a per cent. too weak, and the specific gravity too low. It is better promptly to confess an error than to allow it to occupy another chemist's time in attempts at verification. I am at present engaged in endeavouring to find out how I was deceived in my experiments.—I am, &c.

Lyon Playfair.

Edinburgh, July 8.

The Sale of Poisons.

To the Editor of the Chemical News.

Sir,—I quite agree with your Correspondent, that no person should commence the business of chemist and druggist who has not obtained a certificate of competency. This should be the case in England; but how much greater a necessity there is for such a law in Ireland it is difficult to say. I was once in a small town in the North of Ireland, some distance from home. In the course of the day I had a violent griping pain, and naturally applied for something to allay it to the druggist of the town. I found that he carried on two *rather* dissimilar trades, for he was a druggist and a publican. In the front room of the house medicine was dispensed, in the back room whisky. On stating the purpose of my visit, the chemico-publican

weighed out some muriate of morphia on a dirty, and, I should imagine, not very accurate pair of scales. He then went to the other part of the establishment, and brought therefrom a tumbler, from which someone had just been drinking porter. In this my medicine was mixed. I ask anyone if it is right that such men should be allowed to dispense medicines.—I am, &c. G. F. R.

Chemical Notices from Foreign Sources.

ORGANIC CHEMISTRY.

Preparation of Caramel and Assamar.—Peligot's way of making pure caramel is to heat the sugar between 215° and 220° C. as long as aqueous vapour is evolved, treat the residue with water, filter, and then precipitate the caramel from the aqueous solution by means of alcohol. It is difficult, however, to wash this precipitate free from the mother liquor, and Dr. J. J. Pohl has found it easier to make caramel in the following way (*Sitzungsb. d. Akad. d. Wissenschaft zu Wien*, Bd. xli. s. 623): He heats cane sugar contained in a metallic vessel which will hold 10 or 15 times the volume of the sugar in an oil bath to 210° or 215° C. as long as aqueous vapours escape, stirring up the mass occasionally with a spatula. The mass is afterwards finely powdered and digested with alcohol for two or three hours, and the digestion is repeated until the fluid no longer tastes bitter. The residue contains, besides the caramel, another body greatly resembling Voelckel's Caramelan. If the heat be continued sufficiently long, the alcoholic solution has an intensely bitter taste, and on evaporation yields a bown mass possessing all the properties of Assamar. This body, it seems, retains its properties in alcoholic solution, but in dilute aqueous solution is slowly changed into sugar again—grape sugar, however, not cane.

ANALYTICAL CHEMISTRY.

Estimation of Oxygen in Organic Matters.—Stromeyer describes (*Annal. der Chem. und Pharm.*, Bd. cxvii. s. 247,) a method of estimating oxygen by a combustion. He employs the oxide of copper which is made by heating gently the carbonate $2CuO, Co_2 + HO$. One part of the substance to be analysed is mixed with four parts of this oxide of copper and two parts carbonate of soda, and placed in a combustion tube with about as much granulated oxide of copper before it. (The oxide of copper is granulated by making it into a dough with one-tenth of carbonate of soda and water, and then pressing it through a sieve.) After the combustion the oxide of copper is dissolved in a solution of persulphate of iron containing free sulphuric acid. The solution is moderately diluted, and then the amount of oxygen given up by the organic matter burnt is determined by a standard solution of mineral chameleon. The author gives a great number of experiments showing the results obtained by his process. The amount of oxygen is in general too small, but the loss never exceeded a quarter of an atom.

TECHNICAL CHEMISTRY.

Herring Pickle.—Messrs. Girardin and Marchand (*Journal de Pharm.*) describe the employment of herring pickle as a manure in agriculture. After describing the process of curing herrings on the north and west coasts of France, they thus describe the liquid in question:—

Herring pickle is a reddish liquid, rendered turbid by various organic matters, as blood, oil, &c., but when filtered it has a deep amber colour. Our authors have, during the past five years, made several analyses of the crude pickle as used for manuring land, and having a density varying from 20° to 25° Beaumé. The following is the mean of several analyses of a litre (1000 gramme measures) of pickle:—

Chloride of sodium . .	255·11 grammes.
Sulphate of soda . . .	5·73 ,,
Phosphate of lime . . .	0·98 ,,
Ammonio-magnesian phosphate,	traces.
Phosphate of ammonia . .	1·92 ,,
Phosphate of propylamine .	3·53 ,,
Lactate of ammonia . .	5·76 ,,
Lactate of propylamine . .	10·79 ,,
Albumen	1·90 ,,
Soluble organic matter . .	15·10 ,,
Insoluble organic matter. .	17·36 ,,
	318·18

Propylamine (C_6H_9N), or its isomer trimethylamine, exists normally in herring pickle. Its presence was first stated by M. Wertheim, and we have confirmed his researches. In an experiment on a larger scale we find that 100 parts of the dry matter obtained by neutralising with chlorohydric acid, the volatile alkalies which are disengaged from it under the influence of potassa or lime consist of

Chlorohydrate of ammonia . .	30·23 parts.
Chlorohydrate of propylamine .	69·77 ,,

We find the aqueous solution of propylamine to possess the following properties:—It is very alkaline, and exhales a strong ammoniacal odour, recalling that of herring pickle. It precipitates the salts of alumina, but an excess dissolves the precipitate. It yields with the salts of copper a liquid of sky-blue colour. Neutralized with chlorohydric acid and properly evaporated, it yields very deliquescent crystals, soluble in absolute alcohol when they are perfectly dry. Chlorohydrate of propylamine combines with chloride of platinum and forms a double salt, which can be isolated in transparent octahedral crystals of a beautiful orange red colour, and preserving a persistent odour of herring pickle. Finally, sulphate of propylamine and sulphate of alumina unite to form an alum like ammoniacal alum, but which is deliquescent.

In the recent pickle, the authors found creatin, inosite, and a body analogous to glucose, whilst in the old and fermented pickle butyric acid was a constituent.

MISCELLANEOUS.

Chemistry of the Comet.—Since the article in the last Number was written, I have been able to get a somewhat more satisfactory observation of the spectrum of the light emitted from this body. The light was concentrated by passing through a compound lens, of large aperture and short focus, before receiving it on to the slit of the spectroscope. A coloured spectrum was distinctly though faintly visible, extending from the red to the blue, the latter colour, however, being very faint, and no violet being distinguishable. The general appearance of the spectrum was similar to an excessively weak solar spectrum. The lines D, E, *b*, and, I fancy, F, were visible; in addition to which there was a suspicion of a faint band in the upper part of the green, but whether this was due to lines or other cause I am unable to say. No *bright* lines could be seen. The light is, therefore, principally of solar origin; the proper light of the comet, if it have any, being very faint in comparison. The above observations refer only to the light from the nucleus and that part of the coma immediately surrounding it.—W. CROOKES.

Gold-Producing Machinery.—A Return recently laid before the Parliament at Melbourne, by the Minister of Mines, shows the rapid progress made to the 31st of December last, in applying steam and machinery to the production of gold in that colony. It shows that on

December 31, 1860, there were 107,572 adult miners—viz., 60,874 Europeans and 28,100 Chinese engaged in alluvial workings, and 18,570 Europeans and 28 Chinese engaged in quartz-mining. The number of steam-engines employed in alluvial workings for winding, pumping, puddling, &c, was 294, amounting to 4137 horse-power. Besides steam-engines there were 3957 horse-puddling machines, 354 horse whims, 128 water-wheels, 56 horse-pumps. In addition to these there were engaged in quartz-mining and crushing 420 steam-engines, equal to 6696 horse-power, 158 whims, 6 water-wheels, 26 whips, and 40 horse-crushing machines. The approximate value of all this mining plant is set down at 1,259,660*l.* and there are in the principal towns in the mining districts manufactories of engines and machinery that compete successfully with those imported from England. Great as is the progress shown by these figures in giving a character of permanency to the supply of gold, it is now probable that the colony is about to enter on a still greater developement of this source of wealth, the alluvial diggers having hitherto been kept idle for a large portion of the year by the want of water. Government are forming large reservoirs for collecting and storing rain on the various diggings, and quartz-mining is likely to receive an immense impetus from the many experiments being made and patents claimed for improved methods of extracting the finer particles of gold from the *débris*, or tailings of quartz that have passed through the ordinary processes of crushing, washing, and amalgamating. Among those thus employed is Mr. Porter, of Italian Gully, near Ballarat, who being engaged in quartz-crushing, announces that he has discovered that by placing 76lb. of quicksilver in the bottom of a retort, and then putting into it 225lb. of tailings, and placing the retort on the furnace until the quicksilver is vapourized, it is by this means brought into contact with all, even the most minute particles, while the loss of quicksilver has been only 6oz. out of the 76lb. placed in the retort. The result alleged to have been obtained in these comparatively small experiments is, it is remarked, "so great that, if the same can be obtained on tons as is announced on cwts., it will be difficult to give an approximate estimate of the extent to which the production of gold will be carried in Victoria; for the great bulk of the colony, from Ballarat to Twofold Bay, and from the banks of the Murray and Ovens Rivers to the parallel of Melbourne, is one great goldfield of more or less richness." The immediate consequence at present is that quicksilver is all bought up at 2s. 1½d. to 2s. 6d., and is now held for 3s. to 3s. 6d.

Hot Water as an Agent in Warfare.—Some years ago, the employment of hot water and steam as a means of defence made incidentally and without special appliances, was signally effective. A small British war steamer, cruising in the China seas, was attacked by a whole fleet of the pirates who infest those waters in such great numbers, and, notwithstanding the best defence that could be made with guns and small arms, they were commencing to board in swarms, when the engineer, without orders, brought out a hose from the boiler to the deck, and by a little well directed squirting, in a very few seconds drove them all overboard into their boats or into the sea, and many who escaped scalding were drowned.

Minerals in Siam.—Mr. H. J. Moyle, of Bake, in Cornwall, who has been travelling in South Africa, was attracted to Siam by its novelty and the facility of exploration disclosed by the recent treaty. Having made his way to Nophburi, about sixty miles in a direct line from Bangkok, he found the country so rich in copper and iron ores (of the former of which the natives made no use, being ignorant of their commercial value) that he returned to Bangkok, and obtained, under a deed from the Siamese Government, permission to work the lodes of that district, on payment of a royalty of ten per cent. of the ores extracted. It must, however, be remembered that the Siamese Government is under no treaty obligation to permit foreigners to work the mines of Siam. The country along the banks of the River Chan Phya (Meinam), as far as Nophburi and its environs, lat. 15 deg. 25 min., is covered with alluvial deposits, or a mixture of these and diluvium The hilly and mountainous districts, extending north and south in this latitude, and running many hundreds of miles in both directions, contain many valuable and rich mineral productions, though the natives do not avail themselves of them by working mines. In these hills I detected several rich and valuable veins of copper ore, principally in grauwacke; I considered them of so much value and importance, that I applied for and obtained permission from the Siamese Government to work them for five years, on payment of a royalty of one-tenth of the ores to the Crown of Siam. Lead and silver ores I also discovered, as well as enormous beds of magnetic iron ore and specular iron ore. The country to the north is carboniferous limestone with positive indications of the existence of coal. The rivers, creeks, and canals, with which this country abounds, extending in many places to the base of the hills, afford great facilities for transport, &c. I am impressed with the opinion that, should a fair portion of encouragement be given, the country of Siam will rival, if not surpass, any country of the East in the richness of its mineral productions.

Telegraphic Extension.—Steps are being taken for carrying out the new system of telegraphic extension in the metropolis and provinces on the principle of a fixed annual rental to public and private establishments, so as to furnish them with an exclusive wire for their own use and private means, hitherto unattainable by the ordinary telegraphs, for the receipt and transmission of intelligence. The wires will be combined into ropes 230 yards in length, containing 40, 80, or 100 wires, according to the requirements of the district; and in connecting different districts a system of triangulation is to be adopted, dividing the environs and towns into a series of triangles, as nearly equilateral as possible, with sides about a mile in length. The supporting posts will be fixed at intervals of 200 yards on the tops of the houses, and it is anticipated that the net-work of wires will, when extended over the metropolis, act as a "lightning" conductor, and remove all danger to be apprehended from lightning.—*Mechanics' Magazine.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Carbon.—The process is not yet published: we will give it as soon as possible.

A Constant Reader will find his query answered in the leader of our last Number.

W. P.—We will make inquiries and communicate the result in a subsequent Number.

J. Barclay.—The subject is now under consideration. We hope shortly to be able to give a series of such articles.

Binitronaphthalin.—W. E. R.—This compound is prepared by acting on naphthalin with strong nitric acid, at a slightly elevated temperature.

W. Gilkes.—We are unable to explain "why the blood does not coagulate in the body of a person killed by lightning." Is it certain that such is the case?

J. J.—The water thrown on to the recent great fire could not have been decomposed by the heat alone. Water requires a temperature approaching that of melting platinum to decompose it, and in our observations on this fire we could not see any parts, even where it was raging most fiercely, where the temperature was as high as a white heat. In only a few instances it reached a yellow heat.

THE CHEMICAL NEWS.

VOL. IV. No. 85.—July 20, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Analysis of Mineral Waters, and on the Arrangement of the Results, by R. HAINES, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

PERHAPS I may be allowed to make a few general observations on the analysis of mineral waters, the popular notions regarding which I have found to be very undefined, if not incorrect. The resources of chemistry are sometimes overrated and sometimes underrated, and in both cases the effect is to discredit its professors,—in the one because the results fall short of expectation; in the other because facts which can really be proved beyond dispute may seem to be beyond the power of the chemist to demonstrate, and are hence viewed with suspicion as being hypothetical, when they are not so.

In the analysis of by far the greater number of compound substances, certain preliminary operations, partly mechanical and partly chemical, are requisite, in order to bring the materials into solution, in which state only can the several acids, bases, metals, and so on, be removed from their combinations by the re-agents employed. But in the case of water, everything is already in solution, and it might be supposed therefore that the analysis must be a matter of comparative simplicity. Such, however, is not the fact; on the contrary, the very solubility of all the constituents deprives the analyst of one of the most ready and accurate means of separating them from each other. But there is another reason why the analysis is of a complex description, viz., the great variety of acids and bases simultaneously present. Each of the bases is, of course, capable of combining with any one of the acids; and as most waters are neutral to test paper, it follows that all, of both acids and bases, must be in some state of combination. The ultimate object of the inquiry is to discover what compounds—what salts, in fact—are present in the water; and we are led to endeavour to separate them directly from each other. Now, the ordinary method of separating salts which may be in solution together is by evaporation and crystallisation; by taking advantage of the various solubility of different salts at certain temperatures, some are made to crystallise out from the hot solution, some as it cools, and others by gradual and spontaneous evaporation; and in this way, by a continuation of the process, the salts are finally obtained distinct. Such a process is applied, on a manufacturing scale, in the treatment of sea and brine spring-waters, &c.

But this method, besides being inconveniently operose and tedious, is far too rough and uncertain in its results to deserve the name of analysis. A modification, however, of this method was adopted in the earlier attempts at analysis, and promised to lead to more correct results with less loss of time. The water was first of all evaporated to dryness, and the saline mass weighed. The constituent salts and other ingredients were then separated, one after the other, by the use of various solvents, which had the property each of dissolving some one or two only of these constituents. Thus alcohol dissolved out the alkaline and earthy chlorides; then cold water, or a solution of sulphate of lime, dissolved sulphates of soda, potassa, and magnesia; then weak acid dissolved carbonates of lime and magnesia, hot nitric or muriatic acid dissolved sulphate of lime and oxide of iron, and silica remained to the last undissolved. The bases in each little group could then be separated without difficulty by the usual means. A method of this kind will be found described in some of the earlier editions of Brande's Chemistry, and in similar works.

This method is faulty for two reasons. In the first place, the solvents used are not altogether without action upon the constituents, which they are presumed to leave behind, so that the several solutions are found to contain small quantities of the latter. Accuracy, therefore, is impossible. The other reason is not so self-evident, but it is even more weighty. It is, that there is no certainty that the salts thus obtained really existed in the water. The acids and bases contained in these salts were of course there; but that they were combined each to each, in the manner represented by the salts obtained by evaporation, there is no evidence whatever to show. If we take the same acids and bases in a free state, cause them severally to combine in various ways to neutral salts, and then mix the solutions of these salts together, we shall, on evaporating the solution, always obtain a saline mass of similar composition, however various may have been the forms of combination into which we had at first thrown the acids and bases. Thus, let A, B, C, be three acids, and α, β, γ, three bases; suppose that on evaporating a solution which contains them in certain proportions the following salts have been obtained α A, β B, and γ C. It is clear that this is not the only way in which these constituents may be combined. No less than five other combinations are possible, thus:—

I.	II.	III.	IV.	V.	VI.
α A	α A	α B	α B	α C	α C
β B	β C	β A	β C	β A	β B
γ C	γ B	γ C	γ A	γ B	γ A[1]

And if the three salts formed by any one of those groups be separately dissolved, the solutions mixed, and the liquid evaporated, the residue will in all cases contain only the three salts first mentioned, viz., α A, β B, and γ C. These salts are deposited in succession as the evaporation goes on, and it will be found on investigation that those which are first deposited are invariably the least soluble of all (in the case supposed,

[1] It will be observed that in this table each binary compound occurs twice. The total number of binary compounds possible is consequently nine.

the nine) forms of combination which can be obtained from the acids and bases.

There is thus strong presumptive evidence that the arrangement of acids and bases which prevail in the dry salts is, so to speak, accidental, and that, whatever may be the combinations in the solutions, the salts may be, in fact, only formed at the instant of their deposition, under the influence of cohesive force, which is so well known to modify the mere chemical elective affinity. The phenomenon is, in fact, identical with the ordinary one of precipitation, and depends on the same causes.

The inquiry leads us back to doctrines which lie at the very threshold of chemical science—those of affinity and combination. In the last century, when chemistry was but in its infancy, Berthollet, a most accurate observer, came to the conclusion that union and decomposition were not wholly determined by affinity, but that the relative *quantities* of the several bodies in presence of each other influenced the nature of the compounds which they might form, thus controverting the older views of Bergmann. But the promulgation by Dalton, in the early part of the present century, of the Atomic theory, and by Berzelius of his electro-chemical theory, tended entirely to discredit the doctrines of Berthollet and his school. More recently multiplied research has turned the current slowly, but decidedly, in the opposite direction. The portion of Berthollet's theory which held that the relative proportions of the constituents in a compound might vary, has, of course, been permanently exploded. Compounds *when formed* must have a certain never-varying composition; but the question of the sufficiency of mere elective affinity to determine what compounds shall, in certain cases, be produced, has met with a different fate. Every day's experience brings proofs that, however true the electro-chemical theory may be in a general way, there are a host of phenomena for which it fails by itself to account; temperature, state of aggregation, degree of solubility, and, what we are now chiefly concerned in, quantity—all modify the results in a way different from that which the mere relations of affinity would lead us to anticipate. Still, however, the question before us remains unanswered—What is the actual state of combination of acids and bases, so long as the solution is too dilute to afford a crystalline precipitate under the influence of cohesion, which, at a certain point, subverts the chemical affinities? It is evident that the ordinary methods of chemical inquiry are at fault, and a decision, if arrived at at all, must be founded on other considerations. The following quotation from the last edition of Turner's Chemistry shows one kind of argument employed. After speaking of a supposed mineral water containing sulphuric and hydrochloric acids, and lime and soda, in which case, of course, sulphate of lime and chloride of sodium will be obtained on evaporation, he continues:—"The late Dr. Murray, who treated this question with much sagacity, observes that some mineral waters, which contain the four principles above mentioned, possess higher medicinal virtues than can be ascribed to the presence of sulphate of lime. He advances the opinion that alkaline bases are united in mineral waters with those acids with which they form the most soluble compounds; and that the insoluble salts, obtained by evaporation, are merely products (as distinguished from educts). He therefore proposes to arrange the substances, determined by analysis, according to this supposition. To this practice there is no objection; but it is probable that each acid is rather distributed between several bases than combined exclusively with either."

I may allude, in passing, to a curious observation which has been made by Dr. Struve, the proprietor of an extensive establishment at Brighton, devoted to the manufacture of artificial or imitation mineral waters. He finds that in mixing the saline solutions with water, not merely the proportions of the ingredients, but also a *certain order of mixing* them, must be observed, otherwise the water will not have in all cases the same taste—a proof, if the observation be correct, that so trivial a circumstance as this may determine the nature of the decomposition.[2]

During the last year or two, an able English chemist, Dr. Gladstone, has occupied himself with this subject, availing himself, for the purpose, of the variations in the tint of coloured saline solutions when mixed with other salts, or diluted with water; and his results, though not absolutely conclusive, tend, I believe, to establish the truth of the opinion above advanced by Dr. Turner, that the acids and bases in a mixed solution are distributed in a more or less complex manner among each other, instead of being paired off two and two, under the operation of simple affinity.[3] Indeed, in the case I previously put, of three acids and three bases, it is quite possible that every one of the nine possible forms of combination may exist, in various proportions, at one and the same time in the same liquid. It is clear, therefore, that the ordinary mode of exhibiting the constitution of mineral waters, by arranging all the acids and bases as combined to such and such salts, is unscientific; it is conventionally adopted for the sake of distinctness, and because the public, for whose benefit these analyses are generally made, require something easily intelligible. The misfortune is, that as every one is left pretty much to follow his own method of grouping, different experimenters, who may have each made an equally perfect analysis of the same water, may exhibit their results in so very different a form, that no one would be able to divine, from mere inspection, that the water analysed had been even similar, still less identical in the several cases.

To chemists themselves the circumstance does not much signify, as they are able, by a few minutes' calculation, to re-arrange the constituents in any way most agreeable to their views; but the public are liable to be misled by it, and to imagine that all such cases of apparent discrepancy must arise from incorrectness or want of skill on the part of some or all the operators.

But the best way by far to avoid misconceptions of this kind, is to give, first of all, the positive results of the analysis, the actual quantities of each acid, base, or other constituent that have been obtained, and then, in a separate table, to arrange them according to such system as may be preferred. The figures in the first table can then be compared directly with those in another, which gives the analysis either of the same or of any other water. It is also to be regretted that no uniform standard of quantity of the water to which to refer the ingredients has been adopted. The standards used are not even of the same nature, some being of weight, some of measure. The former is the most scientific, and was used by Berzelius and many of the Continental chemists, the quantity of water assumed being usually either 10,000 or 1000 parts. In Germany

[2] See "Miller's Elements of Chemistry," 1856, part ii. p. 1093.

[3] A summary of the latest experiments on this subject by Dr. Gladstone, and by Malaguti, will be found in the second volume of Dr. Graham's Chemistry; but by far the most complete and exhaustive view of the whole subject is given in the first volume of Gmelin's "Handbuch der Chemie," a translation of the latest edition of which is now under publication by the Cavendish Society.

the Prussian Civil Pound of 7680 grains, equal to 16½ oz. avoirdupois, is made use of. But a standard of measure is now most commonly used on the Continent; this is generally the litre of about 35 fluid-ounces. In England the variety is most perplexing; in the older analyses the wine pint is used, containing 16 fluid-ounces of 455·6 grain measures each; in the later analyses the imperial gallon of 70,000 grain measures is preferred, but sometimes the imperial pint of 20 fluid-ounces of 437·5 grain measures each, or 8750 grain measures in all, is used, and occasionally a bulk corresponding to 10,000 grain measures of water, or one-seventh of a gallon; the last will not, in the majority of cases, differ by more than a very few thousandth parts from 10,000 grains weight.

TECHNICAL CHEMISTRY.

On the Origin and Progress of the Phosphorus and Match Manufactures, by G. Gore.

(*Continued from page* 18.)

When we consider that 1000 parts of urine contain scarcely one part of phosphorus, and of this probably only a portion was obtainable by the processes first in use, we shall not be surprised at the statement of Boyle that "the liquor yields but a small proportion of the desired quintessence," or at the price of 50s. an ounce charged by Hanckwitz for his product. Even an improved process, purchased and published by the French Government in 1737, yielded, under the direction of Hellot, Geoffroi, Dufay, and Duhamel only four ounces of phosphorus for every five hogsheads of the liquid.

After the death of Hanckwitz, in 1741, some experiments were made by Margraaf, Fourcroy, Vauquelin, and others; but no great improvement in the production of phosphorus appears to have been effected until 1769, when Gahn made the important discovery of phosphoric acid in bones. Margraaf had already demonstrated the individuality of this acid as early as the year 1740, and it only now remained to devise a process for extracting it. Scheele immediately did this, and various eminent chemists quickly succeeded in making various improvements in the method of working, and bequeathed unto us substantially the same process of manufacture as that now in operation.

The present sources of phosphorus are the bones of buffaloes and other animals, slaughtered in the great hunting-grounds of South America (the Pampas bordering the La Plata), where bones are used as fuel; exhausted "bone-black," or "animal charcoal" of sugar refineries; calcareous deposits of phosphate of lime, or "mineral guano" from the coast of Yucatan; and similar deposits from the Island of Sombreros; but the chief of these sources is the burnt bones from Monte Video, Rio Janeiro, Rio Grande, &c., and the animal charcoal of the sugar refineries. These various substances contain from 60 to 90 per cent. of their weight of phosphate of lime, or from 12 to 18 per cent. of phosphorus.

The phosphorus-yielding material, of whatever kind, having been suitably ground, a weighed quantity of the powder is placed in a large circular tub, lined with lead, with a mixture of oil of vitriol and water, and stirred by means of a revolving wooden stirrer, driven by a steam-engine, steam being admitted by a pipe into the mixture to facilitate the action of the sulphuric acid upon the powder.

The changes which bone-ash or other varieties of phosphate of lime undergo in the above operation are these: the oil of vitriol or sulphuric acid gradually unites with the lime and forms sulphate of lime, and sets the phosphoric acid free; so that after the process there remains a semi-fluid mixture of a solid substance, sulphate of lime (gypsum or plaster of Paris), with a fluid body, phosphoric acid, separable by filtration.

The creamy mixture is now transferred, by means of ladles, to a filter or drainer, from which, with the aid of occasional stirring, the phosphoric acid filters into a vessel beneath. Water is added to the drained contents of the filter until the drainings cease to taste acid. The sulphate of lime or gypsum is then removed, in its damp state, to a furnace or other source of heat and dried, and constitutes a residuary product suitable for the manufacture of artificial manures.

The dilute filtered solution of phosphoric acid, containing some phosphate of lime and a small quantity of sulphate of lime dissolved in it, is transferred to leaden vessels and slowly evaporated over a gentle fire; the small quantity of gypsum then deposits itself upon the bottoms of these vessels and is removed by scraping. The liquid is deprived of as much more of its water as possible by further evaporation in similar vessels, and on cooling acquires the consistence of cocoa-nut butter.

The butter-like paste is then well mixed with a due proportion of powdered charcoal, and the mixture heated in furnaces of brick or iron until it is brought into as dry a powder as can be attained. The powder consists of charcoal, phosphoric acid (a compound of phosphorus and oxygen), a little phosphate of lime, and a little water, which is chemically combined with the phosphoric acid, and not capable of removal by the means yet applied.

We have already alluded to the intense heat employed by Boyle and Hankwitz in their distillation of phosphorus: the same is also necessary in the present mode of manufacture. The vessels in which the phosphorus is separated consist of a number (about ten) of small retorts, of a convenient shape, carefully constructed of the most refractory fire-clay, narrowed at their mouths, and arranged nearly close together in a horizontal row in a furnace, somewhat similar to the retorts in a gas-works. They are placed in a nearly horizontal position, with their open ends slightly raised, and in a furnace so constructed as to subject them to nearly a white heat.

The black powder is introduced into the retorts when the latter are comparatively cool, and the retorts are about half filled with the mixture. Bent pipes, open at both ends, are inserted, air-tight by means of clay, into the mouths of the retorts, and their outer ends dip into warm water, in cast-iron basins, placed to receive the distilled phosphorus. I may now incidentally remark that all the manipulations with ordinary phosphorus in its simple and separated state are performed under the surface of water, otherwise it would quickly inflame and be reconverted into phosphoric acid.

The heat of the furnace is gradually raised, and in the course of some hours phosphorus begins to distil over, and accumulates in a melted state in the basins of water. The fire is still further raised, by gradual means, until a most intense heat is obtained; the phosphorus then distils rapidly. The heat, after being thus continued as long as any more phosphorus appears, is gradually decreased, and the basins containing the crude phosphorus are removed. The time occupied in the distillation is, in some cases, protracted from forty-eight to seventy-two hours.

In this operation the charcoal, at a high temperature, combines with the oxygen of the phosphoric acid, forming therewith carbonic oxide and carbonic acid gases, which escape through the nose-pipe, and the phosphorus thus set free is converted into vapour by the heat and distils over into the receiving basins. At the same time, the portion of water not extracted by the preceding process is also decomposed, and its hydrogen set free, combines with some of the phosphorus and forms phosphuretted hydrogen gas. The inflammable gases, carbonic oxide, and phosphuretted hydrogen, are conducted away from the phosphorus basins by means of a pipe and consumed.

When the distillation is at an end the furnace is cooled down and the residuary contents of the retorts extracted. The residue consists chiefly of charcoal (of which there is always an excess) and of undecomposed phosphate of lime, together with a few impurities, and is used in the composition of manures, the phosphorus in it being of too difficult or too unprofitable extraction. From the penetrating and destructive character of phosphorus, the retorts require frequent renewing, some manufacturers, when the best fire-clay is not employed, not using them for more than one operation.

The appearance of a phosphorus distillery containing between 200 and 300 retorts, which we have frequently visited when in full operation, and the furnaces at their maximum heat, is somewhat fearful:—The long, yellow flames of phosphuretted hydrogen and carbonic oxide shooting forth from the escape pipes; bits of burning phosphorus spitting forth in fiery balls from little crevices or leaks at the mouths of the retorts; the incessant bubbling of the vapour of phosphorus and escaping gases in the basins of hot water; the almost unbearable heat from the furnaces on each side, and from the red-hot flues under foot; the intolerable stench of phosphuretted hydrogen and burning phosphorus; together with the acid fumes, and filthy grim aspect of the place, combined to produce an impression on our senses which we cannot fail to remember.

The small cakes of crude phosphorus, each weighing several pounds, are collected from the iron receiving-basins when cold and melted together under water. The impurities which were carried over from the retorts into the basins by the current of gases and phosphorus vapour, now settle to the bottom of the fluid mass, and the supernatant phosphorus is drawn over into shallow copper pans, containing a small quantity of hot water to prevent contact of air, by means of leaden syphons previously filled with hot water, and allowed to solidify.

The large cakes or cheeses of phosphorus thus obtained still contain impurities, and are of a dirty red colour, chiefly arising from the mechanical admixture of a red variety of phosphorus in small particles. They are broken to pieces under cold water, and the fragments placed in hot water contained in a leaden vessel (heated by steam), together with a bleaching agent. The phosphorus is stirred with the heated mixture until it is bleached, or its brownish colour is removed, which generally occupies two or three hours.

The liquid phosphorus is again drawn by means of syphons into shallow copper pans, and allowed to solidify. It is then broken under water, and the pieces are placed in hot water in a double-sided (or steam-jacketed) vertical iron cylinder, lined with lead, with a perforated bottom covered with chamois leather and canvass, and while in the fluid state pressure is applied to the phosphorus, and it passes through the leather, &c., into a vessel of hot water beneath, leaving the residuary impurities, red phosphorus, &c., upon the cloth in the form of a dirty reddish substance of an earthy appearance.

The bleached and purified phosphorus is now cast into wedge-shaped pieces, or it is moulded into cylindrical sticks, half an inch in diameter, and ten inches long, by the aid of glass tubes immersed into the phosphorus under water, or by means of an apparatus with tubes specially contrived for the purpose. On some occasions the phosphorus is very brittle and difficult to draw into sticks, but if it is in a satisfactorily pure state it is as ductile as lead or soft copper wire. The appearance of the purified phosphorus in the form of wedges is that of very transparent wax or glass of a slightly greenish-yellow colour, but when in the form of sticks it usually appears colourless. It is needful on all occasions to protect the purified substance from strong daylight, otherwise it soon becomes yellow and opaque. For conveyance it is always packed in water, generally in tin cans, the covers of which are soldered air-tight.

The phosphorus we have described is that of the ordinary kind, but there is another variety equally pure discovered in 1848 by Professor Schrötter, of Vienna, which is produced as follows:—The ordinary phosphorus in its purified state is placed under water in a cast-iron boiler over a furnace; then melted, cooled, and the water removed from its surface. The vessel is then immediately and securely closed, air-tight (except a small iron-tube for the escape of vapour), by a cast-iron cover. The lid has a vertical iron tube, closed at its lower end, fixed in it, which projects downwards into the phosphorus, and is open at its upper end for the reception of a thermometer. Heat is now gradually applied by means of the furnace until the phosphorus is at about 450° Faht., and that temperature is maintained for a greater or less period of time, according to the amount of phosphorus operated upon, and the mass is then allowed to cool. A quantity of about 200 pounds is kept heated about three or four weeks. After this process the vessel is opened, and the phosphorus, which has now become a hard, red brick-like substance, is covered with water, and extracted by means of iron bars, &c. This process of conversion requires to be conducted with great circumspection, otherwise (from overheating of the phosphorus) fearful explosions may ensue; experience has, however, shown that they may be almost wholly avoided.

For commercial purposes the red or amorphous phosphorus, as it is termed, is required to be in a state of fine powder; the stony fragments are, therefore, broken into small pieces under water in a mortar, and ground under water between pieces of mill-stone in a vessel supplied with a small stream of water, which carries off the finer particles in its overflow stream into a large tank, where they gradually subside, or into a filter where they are collected. A process is then resorted to for the separation of any ordinary phosphorus which the powder may contain.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On the Detection of Croton Oils in Mixtures, by John M. Maisch.

It may be sometimes of importance to prove in a fixed oil the presence of croton oil. Its peculiar effect upon the skin will show it whenever it occurs in a considerable proportion. There is, generally, little danger of mistaking for it other oils of similar properties; as, for instance, the sulphuretted oils of mustard, garlic, &c.,

which manifest themselves by their odour. Fixed oils, however, might contain a sulphuretted oil, with its odour masked by some other perfume, and in so small a proportion as to produce only after several applications a slight inflammation of the skin; croton oil might be present under similar circumstances, and the question would then occur, How are we to prove the presence of croton oil? We can readily prove the absence of sulphur, but this would not prove whether or not croton oil was contained therein, unless we were by distillation to remove all volatile matter from this mixture. Small quantities cannot be well analysed in this way, as the inflammation produced might be too slight; besides, this method would not be one easily executed.

In searching for a convenient and ready mode for proving in oily mixtures the presence of croton oil, I availed myself of the results of Dr. Thomas Schlippe's researches on croton oil, (*Annalen d. Chem. und Pharm.* cv.) who, without being able to discover the cathartic principle, found the rubefacient ingredient, *crotonol*, to be a resinous principle, which, together with other resins and free acids, is removed from the oil, by agitation with an alcoholic solution of caustic soda, and then separated by neutralising the solution with hydrochloric acid. This mixture of various components of croton oil possesses the property of reddening the skin in a high degree.

I have followed strictly these directions, sometimes substituting for the soda, caustic potassa, and sulphuric for hydrochloric acid, with the same good results. Experimenting, first, with mixed oils, containing from $\frac{1}{8}$ to $\frac{1}{16}$ of croton oil, I afterwards operated with olive and almond oil, containing one drop to the ounce. The quantity of caustic potassa is regulated according to the amount of croton oil, or, if unknown, in accordance with the effect of the oil upon the skin. For oils insoluble in alcohol, I have used 85 per cent. alcohol, adding to it a sufficient amount of an alcoholic solution of caustic potassa, and agitating well; after separation had taken place, I removed the alcoholic liquid, and added to it an equal amount of water, and a sufficient quantity of sulphuric or muriatic acid. Soon an oily liquid rises to the surface, which, when applied upon the arm, produces in the course of three or four hours not only inflammation, but also the pustular eruption peculiar to the effects of croton oil. If the quantity was small, the acidulated liquid was shaken with strong ether, the ether evaporated, and the residue applied.

For castor oil, and in the presence of volatile oils, I have employed diluted alcohol, mixed with an alcoholic solution of potassa, and omitted the dilution of the decanted alcoholic liquid. The results were equally satisfactory, and in this manner I have detected croton oil, in the so-called castor-oil capsules.

It appears to me possible that croton oil may in this manner be detected in the stomach of animals poisoned by it; but not having the leisure for further experiments at present, I shall have to defer this subject until some other time.

According to Dr. Schlippe, croton oil contains about 4 per cent. of crotonol, and it is therefore necessary to operate very carefully, and without wasting anything. One accustomed to work with small quantities will not fail to detect it.

In conclusion, I will remark, that in pills and emulsions, croton oil is detected in precisely the same way; these preparations are first exhausted with ether, and the residue from the evaporation of the ether is employed.—*Amer. Journal of Pharmacy.*

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, May 10, 1861.

The Duke of Northumberland, *K.G. F.R.S., President, in the Chair.*

On the Relation of the Vegetable and Animal to the Inorganic Kingdom, by William Scovell Savory, *Esq., F.R.S.*

After some introductory remarks to show that plants and animals, when viewed in the relation in which they stand to inorganic substances, may fairly be regarded as together constituting one great kingdom of nature—the organized, the speaker proceeded to consider the relation of organized to inorganic bodies, in structure, in composition, and in function. He challenged the truth of the cell doctrine, and asserted that its leading propositions were not tenable. Not only are some of the simplest tissues of the most complex plants and animals formed without the direct agency of cells, but also that elaborate tissue, striated muscular fibre. He referred to the common Amœba or Proteus, as an example of a living form, simpler than an unicellular organism inasmuch as it exhibits no distinction of cell wall and cell contents; and to Actinophrys, as an illustration of a structure apparently cellular, produced by simple reticulation of a structureless amorphous substance. Vegetable cellular tissue has been generally supposed to be formed by the multiplication of distinct cells, but there is better evidence of its production by a similar process of reticulation of protoplasm. The simplest forms of life, and the simplest tissues of the highest, reveal no difference in structure,—no distinction of parts to the severest scrutiny, and cannot, therefore, as heterogeneous bodies, be distinguished from homogeneous inorganic matter.

Chemistry draws no line of demarcation between the organized and inorganic kingdoms. All questions of composition are of degree only, not of kind.

Life constitutes the grand distinction. The difference is infinitely greater between living and dead organic matter than between dead organic and inorganic substances. Without attempting to describe it, life may be distinguished by its effects. In life, when reduced to its simplest terms, and separated from all those elaborate details which invest it in the more complex forms, there exists a definite relation between destruction and renewal, a regulated adjustment between waste and repair whereby the condition is maintained, notwithstanding constant change.

Life is not a state of resistance. The proofs of this are clear and complete. Waste or destruction is a necessary, an inevitable condition of its manifestation. It is involved in every vital act. And the power of compensating for this waste or change, the repair or reproduction necessary to the continuance of life, involves that of assimilation,—the power of converting foreign matters into the structure of the organism: in other language, the power of appropriating food.

We cannot conceive life without including these two conditions—consumption and supply. Life is not a state of change only as opposed to stability; for this is simply a question of degree everywhere, and dependent on the conditions to which bodies are exposed. Neither dead organic nor inorganic bodies are immune from change. Nor is life peculiar as a process of repair only; for this may occur in inorganic bodies, as crystals, under favourable circumstances. But in life there is the constant and concurrent operation of these two processes, whereby it is distinguished from mere change on the one hand, and from repair on the other.

It does not appear that we can at present safely venture

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further than this. If we attempt to define the vital process of nutrition, distinctions fail us.

The investigation of the phenomena of life has not been in any way assisted, our knowledge of the vital processes has not been in any measure advanced, by the assumption of what has been styled a "vital principle;"—an empirical term, which, like some others when employed in physiology, is, even at the best, equivalent to nothing more than the final letters of the alphabet in an algebraical formula: for it is, when used in its least objectionable sense, a mere expression of something unknown. But the assumption of such an agent or principle, however designated, annihilating or suspending the operation of forces acting elsewhere, has not proved altogether harmless in its influence upon the progress of knowledge. By referring all vital actions to this obscure agency, while nothing was thereby explained, inquiry was to a great extent, and for a long while, checked. Many dazzled by the idea that the nature of vital phenomena was exalted by thus associating them with some mysterious and peculiar principle apart from, and opposed to those agencies which act elsewhere, missed the grander conception, that even in the vital functions may be recognised the operation of forces, some of which, at least, are common to both kingdoms of nature; while, between these and others which appear to be peculiar to living tissues, it is probable that a relation may exist like that which prevails between the chemical and physical forces.

Again, it is needful to beware how we create artificial distinctions. Is there not much assumption involved in the confession that we are unable to construct the simplest form of living tissue? Men sometimes talk as if their powers were limited only by life. But can we construct a crystal any more than a nucleated cell? We may fulfil certain conditions, under which, as we have learned from experience, crystals are formed; but what is our share in the act itself? In like manner we may take a seed or an egg, and place them under circumstances in which they will develope. In either case we are acquainted with the necessary conditions, and we fulfil them. We can do no more.

The speaker concluded with some remarks on the fact that the tendency of advancing knowledge is to efface the lines of demarcation which have been hitherto drawn between the Natural Kingdoms.

THE SOUTH KENSINGTON MUSEUM.

Monday, January 7, 1861.

On the Importance of the Study of Chemistry, by A. W. Hofmann, *LL.D., F.R.S.*

(*Concluded from page* 11.)

I might go on for hours quoting illustration after illustration, but I must limit myself to pointing out a few of the advantages which the most important branch of human industry, *agriculture*, owes to our science. At an epoch when the resources of the agriculturist seemed almost exhausted, chemistry offered her hand, to lead him up a new ascent of improvements. An accurate study of the composition of plants, taught us the actual nature of their food,—that it was partly obtained from the atmosphere, and partly from the soil. It taught, likewise, that while the nutriment derived from the air (identical for all plants), is continually restored to it by the never-ceasing processes of respiration, combustion, and putrefaction; the mineral aliment (varying with each vegetable species), is drawn from a source which is liable to exhaustion. The knowledge of the importance, to the development of plants, of a due supply of their mineral constituents, implied the recognition of the necessity of faithfully restoring to the soil such inorganic matters as are removed from it in our crops. This principle sealed the pledge of alliance between agriculture and chemistry. To keep up the fertility of his fields, the cultivator of the soil had to make himself acquainted with its general composition, as well as with the nature both of the particular substances, which he is annually extracting from it, and of those with which he must supply the loss. For each of these purposes the aid of chemistry became indispensable to the farmer. Davy's excellent work on agricultural chemistry first called the attention of the more intelligent British farmers to the value of chemistry in the improvement of their art, but it is only within the last twenty years that the attention of agriculturists has been generally directed to the subject, more particularly by the works of Liebig and Boussingault. The nature of manures once clearly defined, almost every agricultural improvement at which practice had arrived by slow degrees, received a satisfactory explanation, whilst a variety of improved applications necessarily suggested themselves. The principles of fallowing and of the rotation of crops, and the theory of soil-burning, are no longer mysteries; the action of lime, of wood ashes, and of bones is now perfectly intelligible. In this country, too high a value cannot be set upon the discovery of new sources of material convertible by the farmer into human food. Chemistry has put us in possession of the excreted wealth, which centuries had accumulated in the islands of the Pacific; and if the means which it has suggested for preventing the enormous waste of valuable matter perpetually and irrevocably swept away by the Thames and others of our large rivers, have not as yet been perfectly successful, it has enabled us to substitute for natural manure, artificial products, for the components of which the refuse of every trade and manufacture is now carefully sifted. Perhaps there is no more striking illustration of the value of the aid which agriculture has derived from her new ally, than the success which of late has attended the search for mineral manures. This search, directed by the philosophical interpretation of a few isolated facts, has been rewarded by the discovery of considerable quantities of phosphate of lime in various parts of England; thus realising the prophetic anticipation of Liebig, that "in the remains of an extinct animal world, England is to find the means of increasing her wealth in agricultural produce, as she has already found the great support of her manufacturing industry in fossil fuel, the preserved matter of primeval forests, the remains of a vegetal world."

Nor is the increase of his vegetal produce the only object in the pursuit of which the farmer relies upon the counsels of the chemist; in the feeding and fattening of his animal stock, he stands in no less need of his instruction.

And here we may briefly allude to the benefits, which *physiology*, *pathology*, and *medicine* in general, have derived, and must still further derive, from the prosecution of chemical inquiry. The investigation of the food of plants was followed by a no less vigorous scrutiny of the food of animals. The materials consumed by animals were shown to fulfil two distinct purposes in their economy, enabling us at once to separate into two distinct classes the substances supplying,—each respectively,—the aliments of nutrition, and those of respiration. In vegetal fibrin and albumen, we became acquainted with a group of nitrogenous compounds, which we find again in the animal organism as the chief constituents of the blood. These materials, prepared by vegetal life, the herbivorous animal receives and assimilates into its blood, to supply the constituents of its different organs and structures.

Again, we have a series of substances, such as fat, sugar, gum, starch, &c., which, though not truly to be called nutriments, as having no part in the construction of the body, are no less essential to the maintenance of life. These substances serve the process of respiration; combining with the oxygen inspired by the animal, they continually compensate the loss of temperature, and thus become the source of animal heat. And here presents

itself one of the most interesting subjects for contemplation,—the animal organism in its relations to the surrounding atmosphere. The full appreciation of the effect of air and temperature on the animal system, was a most important step towards a true understanding of the conditions of health. A vast number of diseases originate in disturbances of the relation between the living system and these influences, the intimate knowledge of which affords to the physician the simplest, safest, and most efficient means of preserving health and of curing disease.

Valuable as have been the fruits of chemical inquiry, still more may be expected from the further prosecution of this study. The notion that the action of most of our medicines is chemical, is daily growing into a general conviction. We admit that with every change wrought by pharmaceutical agents in the state of our organism, there occurs a corresponding change in its composition, resulting from their reaction on one or more of its constituents. But of these transformations, which doubtless could be expressed in numbers as definitely as can our laboratory-processes, how few are we in a condition to explain; in how few instances has the physician even a vague conception of the mode in which any medicine performs its office! Nobody doubts the power, which the principles of the Cinchona bark, or of tea and coffee, exert upon the living body, but we are perfectly in the dark as to the way in which they act upon the animal economy. But if we meet with a series of similar substances in several animal fluids: *e.g.*, *urea* and *creatine*, almost constantly present in urine, *glycocoll* generally, and *cystine*, occasionally, excreted in the same liquid, and if we find that all these substances exhibit in their chemical relations a close analogy with quinine and theine, we begin to feel a sort of anticipation of the manner in which these agents may act upon the system. Such examples illustrate at once the nature of the aid which the therapeutics may confidently expect from the progress of organic chemistry. Medicine some years ago found itself in a predicament very similar to that of agriculture at the same period; its resources appeared to be in a state of exhaustion, the rich capital of facts accumulated in the department of organic morphology by the industry of the anatomist, and by the acumen of the physiologist, could not yield its full fruits until an equivalent of knowledge had been drawn from the study of bio-chemical phenomena. This state of things, however, is rapidly changing; associated with chemistry, medicine no longer draws the veil of vitality over processes, the mystery of which may be unlocked by the key of analysis; it no longer shrinks from climbing, step by step, the ladder of recognition, because its upper extremity, disappearing among the clouds, seems to rise for ever beyond the grasp af inquiry. The special zeal with which the field of organic chemistry has been cultivated during the last thirty years, the simple and accurate methods which we now possess for determining the composition of organic products, the amount of analysis actually performed, and, more than all, the still untiring energy of the numerous labourers in the same field of investigation, hold out the promise that the connexion between medicine and chemistry, becoming daily more intimate, will be productive of benefits, the importance of which we can scarcely venture to estimate in the present state of our knowledge.

I have thus endeavoured to indicate some of the most remarkable features of the new field, into which the present generation has been conducted by natural sciences and especially of chemistry. I have tried to sketch the prospects, which a continuation of these labours promises to open before us. It remains to me now to consider the cultivation of chemical science under its other equally important aspect, as the unfailing source of the purest and highest intellectual enjoyment, and as a means of mental training, more effectual perhaps than any other discipline.

If poetic antiquity endowed with a new soul him who learnt to speak the language of another people, how shall we find a fit term to express the sharpening of our perception, the enlargement of our views, the opening of a perfectly new sphere of vision, accruing from the acquisition of a language which unfolds to us the comprehension of nature? Phenomena so common that we are accustomed to pass them by almost with indifference, how are they changed,—I might say ennobled,—by the light that science has shed over them! True it is that the guiding hand which, according to immutable laws, rules over the economy of nature may be recognised without the aid of science. It is visible to everyone who, with an open eye, looks into the world; but no one familiar with the mutual relations by which nature's phenomena are linked together, could deny that with each step forward in the field of research, the conviction becomes more deeply rooted, and that each new observation discloses a new source of the most elevated contemplations.

When glancing, in a former portion of this lecture, at the benefits arising to agriculture and medicine from the progress of chemistry, I have already hinted at the inquiries which have for their object the examination of the chemical conditions of vegetal and animal life, and at the light which they have thrown upon the true nature of respiration and nutrition. I am inclined to look again at these inquiries from a different point of view. They have taught us that animal respiration is a true process of combustion; in order to secure the necessary warmth, we have to burn at every moment a part of our body; this source of heat lasts so long as we supply to the seat of combustion continually renewed fuel; so long as the alternation of breathing maintains the supply of the necessary amount of oxygen, and accomplishes the removal of the products of combustion, *i.e.* of water and carbonic acid. With each respiration the animal robs the atmosphere of a certain quantity of oxygen, and introduces into it a proportionate bulk of carbonic acid. If we consider that the endless processes of combustion, carried out for domestic purposes and for the purposes of industry, produce the same effect; that, lastly, the transformations of organic matter, which we designate as putrefaction and decay, are, in many respects, nothing but processes of slow combustion: it is evident that the unlimited continuance of these conditions must gradually involve a change in the constitution of our atmosphere. Such a change has not yet been observed. It has been justly argued that the immense space of the atmosphere necessarily renders changes of this sort extremely slow, that our analytical methods are not sufficiently accurate, that our experiments do not extend over a sufficient length of time; nevertheless, who could fail to perceive that the compensation is furnished by the difference of conditions which govern the life of the plant in contradistinction to that of the animal? With its leaves, as with so many lungs, the plant withdraws the carbonic acid from the air. Under the influence of sunlight the carbonic acid splits into its constituents—the carbon is employed in building up the plant, whilst the oxygen is returned into the atmosphere. The plant is referred, for its support, to the compound which the animal ejects from its organism as no longer serviceable for the purposes of its life; but it requires only a part of this compound; the rest is set free, again to take part in the development of a new animal generation.

How simple and how wonderful are the means which Nature employs to fulfil her least, as well as her greatest designs!

A mine of interesting considerations is opened by the phenomena to which we have slightly adverted. The carbon of the plant is derived from the air, in which it exists in the form of carbonic acid. The carbonic acid is, as we have seen, partly furnished by the respiration of the animal; but in combustion as in decay a supply of

carbonic acid no less inexhaustible is secured to the atmosphere. But with how new a signification do these processes become endowed when we view them in relation to vegetal life! Combustion, which suggests to the ordinary observer the idea of destruction—decay, which we are in the habit of considering as the symbol of death, in the eye of the chemist are but changes of form bearing the germ of a new unfolding of life. Of all the changes which surround us in nature how different are the views we take, when once the study of chemical phenomena has convinced us of the indestructibility of matter, when once we have accustomed ourselves to consider, as fixed and unalterable, the sum of matter which, under the influence of the forces of nature in the processes of vegetal and animal life, is capable of assuming so endless a variety of form!

Contemplations of even a higher order have been attached to this recognition. No one is likely to deny the danger of attempting to refer the conditions of spiritual life to the laws of the material world, still, this speculation, which appears so consonant to ordinary conception, has been at all times indulged in. If in the gradual development of the cell, of the organ, of the animal,—each phase of which, although fulfilling a definite purpose of the present, nevertheless points to a future end as yet unfulfilled,—physiologists have seen but a special case of a much more general law, which governs likewise the unfolding and ultimate destiny of the human mind;—can we wonder that in the indestructibility of matter (the medium in which all these transformations are accomplished without a particle of it being lost),—chemical philosophers should with delight have imagined they had found a measure applicable to spiritual life, and that indestructibility of matter thus became to them a symbol of the immortality of the soul?

Thus we see emanating from the results of chemical inquiry a rich vein of considerations such as must be acceptable to every thinking mind; but these considerations are by no means limited to objects of general interest. No department of knowledge,—no branch of study,—can be imagined, but what might draw from the stores of chemical experience important solutions and significant suggestions. We find abundant proofs of this assertion in the chemico-agricultural, and chemico-physiological inquiries of Liebig, the general results of which are embodied in his admirable "Familiar Letters on Chemistry." The merchant, the political economist, the statesman, the ethnographer, the historian, each of them finds in this book numerous questions, in which he takes a lively interest, elucidated from the chemical point of view. Let us select a few examples from the superabundant material teeming on every page of Liebig's letters.

The ethnographer makes us intimately acquainted with the manners and customs of different nations, but how seldom does he go a step farther and attempt to explain such manners and customs (which are certainly not accidental) by referring them to the physical conditions of life of the respective nations, to the geographical situation or the climate of the countries which they inhabit! We obtain the most circumstantial accounts of the dietetics of different races, we learn with a sort of discomfort the small portions of, as we should think, unsubstantial nourishment which satisfy the inhabitant of a tropical country, while we lay aside with disgust the bill of fare of the Esquimaux, informing us of the quantity of blubber which constitutes the chief ingredient of his meal. How clearly has Liebig proved the natural necessity for this difference in the choice and quantity of food, by showing that it depends on the quantity of carbon, the combustion of which, under given circumstances, is required for the preservation of sufficient warmth! We have as little reason to admire the South for its moderation as to reproach the North for its extraordinary appetite. Every one who has lived some time in a tropical climate recollects how his appetite diminished; whilst our Arctic travellers, as we see by their journals, become quickly reconciled to Polar diet. It is well known, moreover, that the beasts of prey of the Arctic regions considerably exceed in voracity the animals of the torrid zone.

If the historian inquires into the causes of the decline and gradual disappearance of the North American Indians, he is led to the perfectly correct conclusion, that a combination of circumstances must be involved in producing so striking a result. In any case he will learn with great interest the chemical conditions which are contributing to this catastrophe. Viewed in the light of chemico-physiological experience, the extinction of the red population must be ascribed to the animal food on which the Indian, as hunter, has especially to rely. The same experience has, in fact, taught us that a given surface of land, when serving the purposes of agriculture, is capable of supporting a number of persons from eighty to ninety times greater than when covered by forests inhabited by a nation of hunters. "Thus we see a scanty tribe of Indians dispersed over immense tracts of hunting ground, which must be considerably extended with the slightest increase of their number; and thus we understand the endless warfare which is decimating those red sons of the wilderness. It is no contest of principles, as with a civilized people, which, sparing the conquered, grants to him an honourable peace, but a mutual war of extermination—the desperate struggle for the morsel of bloody flesh which, like the beasts of his forests, the Huron tears with his teeth!" (Schödler.[6])

It would be easy to multiply examples of the same kind, but I would rather allude, in conclusion, to the importance of the study of Chemistry, as a means of education apart from the advantages (accruing from the acquisition of such a vast variety of positive knowledge), which I have endeavoured to point out in the earlier parts of this lecture.

No one doubts the influence which mathematical pursuits have in developing the mental powers. No one can deny that the precision of thought, the correct inference from given premises, essential to progress in mathematics, gradually becomes a habit, which is soon transferred to intellectual labour of any other kind. The mathematician starts from certain fundamental truths, which, without external aid, he is capable of elaborating out of his own mind; and on this basis he piles up, step by step, the wonderful edifice of his science. It is this nature-like mode of construction, disdaining to raise another stone before the previous one is thoroughly secured, which constitutes the value of mathematics, as an element of menta training.

The pursuit of Chemical studies involves no less the development of the mental powers; it leads no less to precision of thought; it improves no less the habit of drawing correct conclusions, which, once acquired, is as easily transferred to other fields of mental labour. Chemistry, as a science, differs essentially from mathematics in this one respect,—that the truths which are its foundation cannot be drawn from the human mind itself. These truths are external to our mind, and can only be obtained by careful observation of the outer world; but, once our mental property, these experience-gathered truths afford a foundation equally adapted for the nature-like unfolding of a system of conclusions, which are not less logically linked together than the conclusions of the mathematician. The chemist has, however, this advantage over the latter:—whereas the mathematician has to find the guidance of his steps within himself, the chemist possesses in nature a mirror which, duly questioned, at every moment readily informs him whether he is still advancing in the right direction.

[6] Discourse on the Study of Chemistry as a means of Education.

NOTICES OF BOOKS.

Lights and Lighthouses: Report of the Commissioners appointed to inquire into the Condition and Management of Lights, Buoys, and Beacons.

The blue book, detailing the evidence taken in the course of this comprehensive Parliamentary inquiry has recently been published in the forms of two massive volumes. These pages enter upon the discussion of several questions in physics, and include the relation of experimental results in many directions of scientific investigation, important in themselves and possessing great interest from the frequent recurrence of names of first-rate repute in science. Professors Faraday, Potter, Smyth, and Airy, Sir David Brewster, Sir John Herschel, Dr. Gladstone, Mr. Way, and Mr. Holmes have all been either directly called upon to assist in the inquiry, or their published investigations referred to for information. Foreign Governments and scientific authorities have also been consulted.

Her Majesty's Commission bears date December 8, 1858, and is addressed to Rear-Admiral William Alexander Baillie Hamilton, and Captain Alfred Phillips Ryder, of the Royal Navy; John Hall Gladstone, Esq.; Duncan Dunbar, Esq., Chairman of the London Local Marine Board; and Samuel Robert Graves, Esq., Chairman of the Liverpool Local Marine Board. The instructions conveyed to the Commissioners aforesaid charges them to inquire into the number, quality, and position of the lighthouses, floating lights, buoys and beacons on the coasts of the United Kingdom; to institute inquiries relative to the efficiency of the lights on our own coasts and those of our colonies, and the cost of constructing and maintaining these as compared with the expenditure for the like objects in foreign countries. Also to inquire whether the present system of management and control is well adapted for securing the most efficient lighting and buoying of the coasts of the United Kingdon and to suggest, if possible, any improvements calculated to ensure the more efficient conduct of that service.

The Report of the Commissioners is dated March 5, 1861. So great is the mass of evidence accumulated for the purposes of the inquiry that upwards of 900 closely-printed pages are taken up with the details of this laborious investigation. The great bulk of these particulars have no special interest for the readers of the Chemical News, but we purpose to devote a few pages in our Journal to the consideration of the scientific portion of the evidence, and to deduce therefrom the more important conclusions arrived at in the course of this inquiry.

With regard to the mode of taking evidence the Committee state at the outset that they have deviated from the system usually followed in similar cases by relying not only on oral evidence, but they have placed themselves in communication, through the medium of printed questions, with many individuals, both in this country and abroad, known to take interest in these subjects, and whose testimony would be regarded as worthy of confidence. On this point the Report sets forth that "*vivâ voce* examination is always best for extracting the truth from the unwilling, but written questions are best for obtaining deliberate opinions from men anxious to give them. A professional man could not be called before a Commission without offering to pay him not only for his expenses, but also for his loss of time. A number of answers to the same question admit of ready comparison, and that whenever a great number of skilled opinions are brought to bear on a single fact, if almost unanimous and from independent sources, greater reliance may be placed on the general conclusion than when a small number are consulted separately."

The Commissioners prepared accordingly a series of questions addressed particularly to men of science. These were distributed among some fifty chemists, physicists, and mathematicians, and their replies were carefully collated and presented as an Appendix to the Report. Special investigations in several departments of experimental science have also been proposed by Dr. Gladstone. These refer to the production of light, its utilization; the space-penetrating power of differently coloured rays; direction and altitude of the light. In reference to fog signals, the study of the most favourable conditions for the transmission of sound. The relative durability of different building materials as applied to the construction of towers and beacons, constantly subject to the wearing action of the waves. Such, in a few words, is an outline of the questions considered in the Report before us. Many of the problems, as that of the economical production of the voltaic and magneto-electric lights, the later modifications of the lime-light have been the subjects of recent experiment, and are likely to meet with renewed discussion in the present day. On this account, therefore, we shall need no apology for introducing them in these columns to the notice of our readers.

In reference to "Circular No. IX." the general purport of the questions addressed to scientific men is as follows:—

I. The evidence of—

Optics.—(Production of Light.)

II. In lighthouses which are *easy of access*, do you think there is any method of producing light better than burning oil to the best advantage?

(Gas is used in some harbour lights. The magneto-electric light has been under trial at the South Foreland, and several other inventions have been proposed.)

III. Taking into consideration the difficulty of transport to lighthouses in remote positions, and the danger which results from an accidental extinction of such light, do you think that the method you have referred to could safely be substituted for oil in lighthouses so situated?

Utilization of Light.

IV. Revolving Lights, &c.—What optical arrangement do you consider best for showing to an observer placed on the horizon, or at any point within it, for short periods, recurring at intervals, the greatest possible quantity of the light produced by the combustion of a given quantity of oil, or by any other given method?

(Metallic and other reflectors, polyzonal lenses, ground, and the same cast, totally reflecting prisms, and combinations of these, are used, or have been suggested.)

V. Fixed lights. What optical arrangement do you consider best for showing continuously and simultaneously to observers on the horizon, and at any points within it, the greatest possible quantity of the light produced by the method to which you have referred?

VI. Do you consider the methods which you have described applicable to floating lights, with or without modifications?

VII. Please to send any suggestions you may wish to offer relative to—

a. The manufacture of reflectors, including materials and shape.

b. The manufacture of glass.

c. The manufacture of lenses and prisms.

d. The placing of optical apparatus in lighthouses, so as to use the light produced to the best advantage, having due regard to the position and elevation of the light.

Colour.

VIII. Can you suggest any means other than the interposition of coloured glass for producing serviceable coloured lights?

IX. Have the goodness to send any suggestion you may wish to make relative to—

a. The manufacture of coloured glass.

b. The placing of coloured glass with reference to the light.

(Coloured chimnies, glass screens within the lens, the same outside, coloured panes in lanterns, and combinations of these plans, have been tried or proposed.)

X. *a.* What colours can, in your opinion, be seen at the greatest distance in all weathers, and at the same time can be most easily distinguished from each other, and from white light?

b. Is white light, or some coloured light, in your opinion, most serviceable in a fog? If the latter, what colour?

XI. Distance. Do you know any method by which the distance from a light may be determined?

a. When the height of the light above the water is known.

b. When the height is not known.

Mechanics.

XII. Can you suggest any improvements in

a. The construction of lighthouses in exposed or other situations?

b. The construction of beacons in similar positions?

XIII. Can you suggest any improvements in the construction of lamps, revolving apparatus, or other mechanical appliances now used in lighthouses, &c.?

Flotation.

XIV. to XVII. These questions relate to particulars of form, and to systems of mooring floating beacons.

Acoustics.

XVIII. What description or pitch of sound is most capable of penetrating a fog? What method do you consider best for producing such a sound?

XIX. What description of fog-signal would you recommend as the most serviceable?

(Gongs, automaton bells, and guns are used, as also reflectors and other contrivances for directing and condensing sound. Mechanical and steam whistles, &c., have been suggested.)

XX. What method do you think best for concentrating sound, or for throwing it in particular directions? Do you think that any method would enable mariners to distinguish with sufficient certainty the direction from which a sound proceeds?

XXI. At what altitude should fog-signals be placed, so as to be heard at the greatest possible distance?

Meteorology.

XXII. What is the elevation at which it would be desirable that light should generally be placed on the coasts of the United Kingdom, having regard to these facts, viz.: the higher the light the greater the distance to which the rays will reach before they are intercepted by the horizon? The lower the light the less likely it is to be obscured by clouds.

XXIII. Supposing the telegraph to be extended to certain lighthouses and light-vessels at salient points of the coast, what is the meteorological information which it would be most desirable to transmit to passing ships, and how and in what form could it be most readily received and communicated by light-keepers?

XXIV. Tide Signals.—What system would you recommend for general adoption in connection with lighthouses at the entrance of harbours, for indicating the state of the tide by day and by night, to persons in the offing?

(Various systems are now in use, including balls, flags, coloured lights, illuminated figures moved by the tide, &c., and others have been suggested.)

XXV. *a.* Are you aware of, or can you suggest any good system for identifying lighthouses and floating lights by day?

b. Can you suggest any improvement in the systems now used for identifying them by night?

In a future Number we shall proceed to a critical examination of the statements made in reply to the foregoing scientific questions.

Report on the Presence of Bisulphide of Carbon in Gas, addressed to Robert Jones, Esq., Engineer of the Commercial Gas Company. By Frederick Versmann, F.C.S. London: 1861.

[second notice.]

Although there can be no doubt that some sulphuretted hydrocarbons are generally present in coal-gas, it is quite certain that the principal sulphur-holding ingredient is the bisulphide of carbon. In whatever form, however, sulphur is present, the only practicable way of estimating the amount is by burning the gas in air, and so forming sulphurous acid, which is then converted into sulphuric and weighed as sulphate of baryta. The great difficulty hitherto has been to effect the condensation of the whole of the sulphurous acid. This would not, at first sight, appear to be a difficult matter; but experience has shown that it is not so easily accomplished.

The water produced in the combustion, when condensed, carries down with it a very small proportion of the acid. Some experiments made to ascertain how much would be secured in this way, gave an average of 24 grains of sulphate of baryta, equal to 3·28 grains of sulphur for the 100 cubic feet—a merely fractional part of the amount which we have shown was actually present in the gas. Even when the condenser is artificially cooled, the greater part of the sulphurous acid would appear to escape, and it is only by fixing it as sulphite of ammonia that it is possible to secure the whole. Several contrivances have been invented for effecting this, one of the most successful being that of Mr. Wright, who ensured the perfect combustion of the gas by burning it under a platinum rosette and then collected the products of combustion in a vessel containing ammonia. In this way over 40 grains of sulphur were found in 100 cubic feet of gas.

The plan which Mr. Versmann adopted is described as follows:—

"A small air and gas-burner was placed inside a very spacious glass-retort, open at the bottom, and afterwards closed by dilute ammonia, contained in a suitable glass-vessel. The retort was then connected with two Woolf's bottles, the first of which contained a solution of ammonia, and the second a solution of iodine in iodide of potassium; the gaseous products of combustion were forced through these liquids by means of a strong air-current, produced by a water aspirator, and thus absorbed.

"The solution of iodine was merely used in case some of the sulphurous acid escaping unabsorbed by the ammonia; but it was found in all these experiments that not a trace of it could be detected in the second bottle.

"The sulphurous acid combined with the ammonia to form sulphite of ammonia was then converted into sulphuric acid by a solution of iodine in iodide of potassium, precipitated by chloride of barium, and weighed as sulphate of barytes.

"This apparatus was connected with the neck of the retort; but a similar one was in communication with the body of the retort by means of a glass tube passing through the dilute ammonia into the body of the retort."

This description, it must be confessed, is not too intelligible; but we very well know, and shall presently illustrate, the difficulty of describing a system of apparatus without the aid of a drawing.

We have said before that we do not intend to question the perfect accuracy of Mr. Versmann's results; but we may just hint at the possibility that the rapid transit of a "strong" current of heated air through a bottle of ammonia would probably leave, in a short time, only a vessel of tepid water, whereby the advantage of the ammonia would be entirely lost; and further, that by passing quickly through the iodine solution, the sulphurous acid might perhaps escape oxidation and get away into the atmosphere undetected. This, however, is mere speculation, but the truth of it is rendered somewhat probable by

the fact that, in the experiments, which lasted a short time, Mr. Versmann obtained a much larger per-centage of sulphur than in those which lasted a longer time. For instance, the combustion of 118 feet gave only 2·96 of sulphur for 100 feet of gas, while the combustion of but 2 feet yielded at the rate of 6·7 in the 100 cubic feet.

The plan adopted in our own experiments is the contrivance of Dr. Letheby, and is at once the most simple and effectual means yet devised for estimating sulphur in gas. As no account of it has yet been published, we shall, with the Doctor's permission, describe the arrangement of the apparatus. This would be better understood with the help of a drawing, but for the present a verbal description must suffice. The objects are, to effect the combustion of the gas in a strongly ammoniacal atmosphere, by which means the sulphurous acid is fixed by the ammonia as soon as formed, and to condense the sulphite of ammonia. These objects are accomplished in the following way:—Two glass cylinders similar to those used for electrical machines are connected together by means of a wide glass tube fitted with bungs. To one of these cylinders is adapted the neck of a retort, which is curved downwards, and widened to admit for some distance the short chimney of a Leslie's burner, which is used to burn the gas. In the centre of the burner, and so as to come a little above the points of flame, a tube is fixed leading from a bottle of strong ammonia. From the end of the second cylinder a wide glass tube is carried a foot or two up into the air, to serve as a chimney and assist in creating a draught. With this apparatus it is only necessary to observe two precautions—to burn the gas very slowly,[1] and to keep up the supply of ammonia. The latter is of the utmost importance. It should be supplied so that the air escaping from the chimney connected with the second cylinder may always be alkaline. A large quantity of water condenses in both cylinders; but that one nearest the burner will be found to contain almost the whole of the sulphite of ammonia, some of which will be seen to have condensed in a solid form on the upper surface of the cylinder. After pouring out the solution, and rinsing out the cylinders and tubes, the sulphite is converted into sulphate of ammonia, and the sulphuric acid determined in the usual way.

Here we might leave this part of the subject, but we will just give the average results of three experiments in which the ammonia was imperfectly supplied, to show the great importance of a regular supply of this gas:—

	Cubic feet of gas burnt.	$BaOSO_3$ per 100 cub. ft.	S. per 100 cub. ft.	Average S.
I.	17·6	222·6	30·53	27·9
II.	22	175·9	24·12	
III.	12·7	210·23	29·08	

With regard to the removal of bisulphide of carbon from gas, Mr. Versmann quotes with approval the opinion of Dr. Frankland published in the last edition of Ure's Dictionary, that there was little ground for hope that any practical means would be devised for its abstraction. He is a bold, if not a rash man, who, in these times, when the apparent impossibilities of one day are continually becoming the established results of the next, ventures to predict, or even to opine, the impossibility of accomplishing anything; and yet chemists are often indulging in vaticinations of the kind. Perhaps before Dr. Frankland had written the above opinion—certainly before Mr. Versmann had quoted it—the thing had been done, and by the use of the most simple means. On the 24th of May, 1860, Mr. J. E. Clift, from whose evidence we have before quoted, told the Committee of the House of Commons—and Mr. Versmann might have read it in the *Journal of Gas Lighting* for June 5—that Mr. Bowditch's process had been tried with success at Wakefield, and that he (Mr. Clift) was preparing to use it at Redditch.

[1] In all our experiments the gas was burnt at the rate of half a cubic foot an hour.

The London Companies, however, are strangely averse to improvements, when the use of them involves any payment to a patentee, and when it is found impossible to dispute a patent right (for which we are informed they have a common fund) they decline to use the process altogether. It remains, therefore, with the public to insist that the provisions of the Metropolis Gas Regulation Act are thoroughly carried out, and if the Companies do not choose to make use of the means for removing bisulphide of carbon, let them take care to prevent its formation.

We shall probably have something more to say on the same subject before long; but for the present we may conclude with the remark, that this Report is another illustration of the value of analytical certificates. In the gas which Mr. Versmann examined for the Commercial Company he found a maximum of 6·7 grains of sulphur in 100 cubic feet. In the gas which the Company supplied to their customers, after the publication of this Report, we found an average of 57·38 grains of sulphur in 100 cubic feet!

NOTICES OF PATENTS.

Sheet Iron. D. A. Morris.

The intention of this patent is to produce on surfaces of sheet iron a hard, black, enamel-like coating, which is said to have great protective action against corrosion and the formation of rust, and also to give an improved appearance to the metal. The film of enamel is stated by the patentee to consist of proto-carbide of iron, and to be composed of one equivalent each of iron, oxygen, and carbon, or represented in chemical symbols, Fe O C.

The mode of proceeding contemplated in this invention would probably confer on the iron surface additional power of resistance against corrosive influences. But, inasmuch as the nomenclature adopted in the specification is a little ambiguous, we are unable to offer a more precise opinion upon the merits of the proto-carbide of iron containing oxygen as a protective against rust.

Colouring Matter. W. Clark. (A Communication.)

In order to obtain pure dye-extracts and brilliant lakes the inventor describes a new mode of treating madder and other tinctorial substances, whereby the more permanent colouring matters are purified from certain associated constituents, which interfere with the brilliancy of the dye. This end he proposes to accomplish by acting on the madder roots or powder with aqueous solution of sulphurous acid, to which a small proportion of sulphuric or other mineral acid has been added.

The principle of this process would appear to be susceptible of wide application, for among those colouring matters which are distinguished by their ephemeral character many are known to be bleached or entirely destroyed by sulphurous acid, while another more permanent class are able altogether to resist the action of this chemical agent.

Separating Copper from its Ores. P. Spence. (Not proceeded with.)

The method of extracting copper described in the specification is applicable to all the sulphuretted ores of that metal, and to the poorer class of residual products obtained in the process of manufacturing sulphur and sulphuric acid from ordinary pyrites. The inventor, in dealing with any of these materials, grinds them to the state of fine powder, which is then subjected to a process

of roasting, at a moderate temperature, in a reverberatory or other suitable furnace. By this treatment the copper is mainly converted into sulphate, which may now be extracted by water, and in this manner separated from iron and the other ingredients of the ore.

The leading features of this invention are precisely identical with the process of treating copper ores patented many years since, and put into operation in this country by the Messrs. Bankart. It has long been remarked that a considerable loss of metal was experienced by the admission of rain to the heaps of roasted ore lying about the copper smelting works; and that iron tools left accidentally exposed to the drainage from these heaps invariably became coated with copper. This old observation appears to have suggested the several modifications of this general system of treatment, which have, from time to time, been proposed.

Obtaining Products from Coal, Gas-tar, Gas-pitch, Coal-tar, Asphalte, Resin, &c. E. Puls.

For the purpose of obtaining products from either of the materials above named, the inventor mixes them with a mineral acid, or with any oxidizing chemical agent, and then subjects the mixture to distillation in any convenient apparatus. Solid materials, such as coal, pitch, or asphalte, should first be broken into small pieces, or even reduced to coarse powder. On account of its low price, sulphuric acid is the oxidising agent generally preferred by the inventor; and in its use this acid requires to be intimately incorporated with the solid substance exposed to its action; but if a fluid, such as coal-tar, be the material employed, it is considered desirable to modify the action of the acid by previously mixing this latter with powdered charcoal, or with any other substance in a fine state of division which will not neutralise its effects.

It would be difficult to define exactly the nature of the chemical products obtained in these processes. Sulphurous acid would in all cases be liberated; but the nature of the fluid products of the distillation must vary not only with the different materials experimented upon, but will depend also on the proportion of acid or oxidising agent employed.

Manufacturing certain Gases applicable in generating Heat and Light, and in Bleaching. C. Binks. (Not proceeded with.)

This invention has reference to the economical production of chlorine and oxygen gases, and is based upon the powers of affinity exerted at high temperatures between certain oxides and the elements of water and of hydrochloric acid. For the production of oxygen gas two methods are proposed. The first depends upon the decomposition of water, in the form of super-heated steam, by the combined agency of chlorine and of a substance capable of uniting with the hydrochloric acid produced. The second method consists in liberating oxygen from the brown or black peroxides of manganese by the action of chlorine assisted by a moderate heat. In regard to the production of chlorine the new process is based upon the decomposition of hydrochloric acid at a high temperature by the conjoint action of oxygen gas and of a material having an affinity for the elements of water.

In the foregoing specification the interesting alternations of chemical affinity appear to have been correctly defined, but in considering the expediency of the methods proposed for the economical production of oxygen and chlorine, we incline to the opinion that the recent suggestion of Deville relative to the preparation of oxygen, and the older methods of producing chlorine will maintain the advantage.

CORRESPONDENCE.

The Great Fire.—Storing Nitre.

To the Editor of the Chemical News.

Sir,—There are many facts well known, but the practical application of which to the ordinary affairs of life is but too often little heeded till some circumstance happen that fully impresses the necessity of making use of our knowledge. The recent great fire in Tooley Street, and the somewhat similar catastrophe which took place not long ago at Gateshead, will at once point to the fact that nitre must not be stored in the same warehouse with inflammable materials—as at Gateshead with sulphur, and in Tooley Street with oil, tallow, &c. Nitre, or saltpetre, is perfectly harmless by itself, and cannot be set on fire; but if sulphur, oil, tallow, or any other burning substances, be in contact with it, then a compound is produced having all the dangerous qualities of gunpowder, of which nitre is the active ingredient. Knowing these facts, it will be obvious that our warehousemen must in future store nitre in such warehouses as contain only incombustible materials. No amount of fire cement, iron doors, or brick walls, will save from destruction a warehouse on fire if it contain nitre and any other body that is inflammable, under ordinary circumstances. As I have before said, nitre is harmless enough by itself; and thus, by your kind aid, calling attention to this known fact, I leave the officers of the Insurance Companies to compel its being warehoused in separate and appropriate warehouses, away from anything that will burn.—I am, &c. Septimus Piesse.

Chiswick.

Pure Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—In reply to the inquiry of your correspondent "A Subscriber," in your Journal of the 29th ult., I shall be happy to supply him with pure sulphuric acid in any quantity and at any time if he will favour me with his address, as I am always making it, and have at this present time upwards of a ton weight in stock.

I am, &c. Philip Harris.

Chemical Works, Bull Ring, Birmingham.

To the Editor of the Chemical News.

Sir,—In reply to the letter of "A Subscriber," in your Journal of the 29th of June last, I beg to inform him that I will supply any quantity of pure sulphuric acid, free from traces of any foreign matters that are injurious, at a very moderate cost. The cause of the inferiority of English acid of the present day is owing to the almost universal use of pyrites instead of the best Sicilian sulphur. The latter is only used at my Works.

I am, &c. F. C. Norton.

Oil of Vitriol Works, Bow Common, London, E.

The Sale of Poisons.

To the Editor of the Chemical News.

Sir,—The discussion which is taking place in your columns on the above subject cannot but be productive of good; it would be an injustice to the public if such an important matter were allowed to remain quiet. The Correspondents in recent numbers of your Journal very properly insist upon the importance of all persons who commence the business of chemist and druggist having a "Certificate of Competency." You refer (in a note appended to one of the communications) to the Pharmaceutical Society as an authorised body whose organization and

requirements are complete; but are you, or are many of your readers, aware, that a scheme is being discussed by the Council and Members of that Society for the introduction of members who have not passed any examination? the sole object of which departure from the original rules of the Society seems to be to increase their funds, which are found to be flagging.

Now, I submit that, should such an innovation take place, the Pharmaceutical Society will lose ground considerably in public estimation. The desire on the part of the Pharmaceutists to raise the educational *status* of chemists was very praiseworthy, and they might eventually, by increasing the numbers of their members, and securing public favour to themselves, have occupied the entire ground now so unequally shared—*i.e.*, in excess—by unqualified pretenders to the trade.

As the case is, however, with regard to that part of the dealings of chemists, which relates to the sale of poisons—it seems high time that the Legislature should enact some restrictive measures as to the kind of persons who may or may not embark in that deadly trade. As well as some compulsory clauses respecting the use of such methods in the dispensing and sale of poisons by authorized chemists that shall seem best calculated to protect the public from that class of accident, which has become but too common of late.

The most effectual plan that has been devised, is the use of the "safety or drop bottles," a description of which appeared in your columns some months ago. I would strongly urge upon the public the necessity of taking this matter into their own hands, and in default of compulsory legislation to that effect, they should, when ordering liquid poison of any description, require it to be sent out in the "narrow-necked bottle;" such a demand would be irresistible, and the object in view would be accomplished.

I ought to apologise for the free manner in which I have expressed my views, with the expectation of a place in your columns; knowing that you do not favour legislation on the subject, but that you advocate "free trade" in drugs; however, you must remember that "free trade" in poisons means free trade in death, for not only does it not afford any protection against accident, but it offers great facilities to the intentional poisoner, and gives a great increase to crime.—I am, &c.

Pro Bono Publico.

Chemical Notices from Foreign Sources.

II. ORGANIC CHEMISTRY.

Oxyacanthine.—Karl Wacker gives (*Wittstein's Viertel-Jahresschrift*, Bd. x. s. 177) a full account of oxyacanthine. This body was discovered by Polex in the bark of the root of the common berberry. The author prepared it from the precipitate produced by carbonate of soda in the mother liquor from which berberine had separated. The precipitate forms a catechu-like mass. This is treated with water, acidulated by hydrochloric acid, the solution is filtered from the resinous matter separated, and then precipitated by ammonia. This precipitate is washed, dried, and then extracted with ether. The etherial solution is allowed to evaporate to the consistence of an extract, which is dissolved in distilled water, with the addition of hydrochloric acid. This solution is largely diluted, and then saturated with ammonia, whereby a tolerably white precipitate of oxyacanthine is produced. By repeated solutions and precipitations it is obtained quite pure and snow-white.

Pure oxyacanthine, $C_{32}H_{23}NO_{11} + HO$, is a dazzling white powder, which, when kept in a shady place, undergoes no change; but when exposed to direct sunlight becomes of a yellow colour. This, however, as in the case of santonine, appears to be only a molecular change, for the solution of yellow oxyacanthine in an acid is again precipitated white by an alkali. It can be obtained in the crystalline state by allowing a strong etherial or alcoholic solution to evaporate spontaneously. The taste is a pure bitter, which does not long remain. It melts to a yellow liquid at 139° C., and at a greater heat gives off empyreumatic vapours, leaving a residue of shining carbon. Chloroform dissolves it easily under all circumstances. Strong hydrochloric acid dissolves it quickly, without occasioning any change of colour. Strong sulphuric acid forms a clear solution, which has a shade of yellow. Concentrated nitric acid gives a brownish-yellow fluid, from which warty crystals soon separate. Chromic acid is reduced to chrome oxide. Chlorine water gives a yellow solution to which ammonia communicates a darker shade, but causes no precipitate. The behaviour of iodic acid is worthy of notice; if a small crystal be placed in contact with either pure oxyacanthine or a salt, and then a few drops of water be added, a smell of iodine is immediately evolved, and starch-paper, touched with the mixture, is coloured blue.

A solution of a neutral salt of oxyacanthine shows the following reactions. Ammonia gives a white precipitation which dissolves in a large excess of the precipitant. The other alkalies and their carbonates give a white precipitate; so does lime-water. Nitro-picric acid gives a lemon yellow precipitate; tannic acid a yellowish cloudiness; iodide of potassium a white, and an ioduretted solution of iodide of potassium a brownish-yellow precipitate. Sulphocyanide of potassium, and bichloride of mercury, give a white, chloride of gold a yellow, chloride of platinum a pale, greyish-yellow, and nitrate of palladium an orange-coloured precipitate. Ferrocyanide of potassium produces a white, the ferricyanide a sulphur yellow. Phosphomolybdic acid gives a yellowish white.

The salts formed by oxyacanthine are all white, and are obtained in warty or acicular crystals, with the exception of the acetate, which will not crystallise.

In conclusion, the author proposes the name of *Vinetin*, from *vinetier*, the French name for the berberry, because the word oxyacanthine calls to mind the *Cratægus oxyacantha* rather than the *Berberis vulgaris*.

Saligenine.—This body, say Beilstein and Seelheim (*Annalen der Chem. und Pharm.*, Bd. cxvii. s. 83), is best obtained pure by crystallization from pure benzole. From a hot solution it separates perfectly on cooling, for one part of saligenine requires 52 parts of benzole at 18° C. to keep it in solution. The sp. gr. of pure saligenine estimated in a cold saturated solution in benzole at 25° = 1·1613. Perchloride of phosphorus acts violently on dry saligenine. By the reaction of two molecules of the former on one of saligenine there are formed saliretine, oxychloride of phosphorus, and hydrochloric acid:—

Saligenine. Saliretine.

$$C_{14}H_8O_4 + PCl_5 = PO_2Cl_3 + 2\,HCl + C_{14}H_6O_2$$

Saliretine was attacked with difficulty by perchloride of phosphorus, and a chlorinated body was produced which contained no oxygen, but gave more chlorine than answered to the formula $C_{14}H_6Cl_2$. The analysis of this body gave C 33·12, H 1·11, and Cl 65·81 per cent. Dried at 150° C. Saliretine has at 25° C. the sp. gr. 1·1161.

By the treatment of saligenine with acetic acid anhydride, and some ether, in a sealed tube, saliretine is formed, which in this way is obtained pure with tolerable ease. The following decomposition-formula explains the reaction:—

$$C_{14}H_8O_4 + \left.\begin{matrix}C_4H_3O_2\\C_4H_3O_2\end{matrix}\right\} O_2 = C_{14}H_6O_2 + 2\left.\begin{matrix}C_4H_3O_2\\H\end{matrix}\right\} O_2.$$

Saligenine appears to form definite compounds with baryta and lime. It easily dissolves in baryta water, and from the solution evaporated in vacuo crystals resembling wavellite separate, which, dried at 100°, have the composition $C_{14}H_9BaO_6$.

III. TECHNICAL CHEMISTRY.

Preparation of Gun Cotton.—A chemist, who

does not give his name, has published (*Archiv. der Chem.*, Bd. cliv. s. 270) an account of a series of experiments which he has made on the preparation of gun cotton. The results he has arrived at may be summed up as follows:—The smaller the quantity of cotton wool operated upon the more easy it is to prepare a good gun cotton. An ounce of cotton wool he found was as much as could be manipulated with safety. The proportions found to give the best results were one ounce of cotton wool, 16 ounces of nitrate of potash, 12 ounces of English sulphuric acid (sp. gr. 1·84), and 12 ounces Nordhausen acid. Five minutes in this mixture was found to effect the change in the cotton perfectly. A longer exposure was not only useless, but mischievous. The temperature at which the action of the mixture goes on best is from 154° to 160° F.

MISCELLANEOUS.

The Cork Trade of Bordeaux.—There are at present in Bordeaux twenty-five cork factories, employing seventy-five workmen, using annually 3,396,846lbs. of cork bark, and producing about 10,000,000 corks. 90,000,000 ready-made corks are obtained from the neighbouring places, Nesac, Bayonne, and Provence. The cork trade of Bordeaux, therefore may be estimated at 100,000,000 corks annually, worth about 156,333*l*. Two-fifths of this quantity are exported to the French colonies, the United States, Chili, India, &c.; three-fifths are used in Bordeaux, at the average price of 1*l*. 4s. per thousand. These corks are divided into four classes—namely, the extra fine, used for champagne bottles, and sold for from 2*l*. to 4*l*. 16s. the thousand; the very fine used for bottles of wine of the first quality, and sold for from 1*l*. 4s. to 2*l*. the thousand; the fine, used for bottles of wine of the second quality, and sold for from 16s. to 1*l*. 4s. the thousand; and the common corks, used for bottles of common wine, and sold for from 2s. 4d. to 16s. the thousand. Nearly all of them are made by hand. There are so many difficulties and disadvantages connected with their manufacture by machinery that the use of machines is unprofitable. One class of workmen cut them into lengths, another turns them, and women are employed to separate them into the different classes named above. One cutter can prepare work for five turners, and one turner can make on an average 1200 a-day. The cutters are paid from 3¼d. to 4¼d. per thousand, and the turners from 1s. 2d. to 1s. 6½d. per thousand; that is about 1s. 6d. a-day.—*Mechanics' Magazine.*

Glass.—Glass has become with us an article so singularly cheap and common, that we are apt to lose sight of its immensely diversified qualities; but if only considered from a philosophical point of view, we shall find that few of the substances which we have in daily use, either in a simple or compound state, can be compared to glass in point of importance and usefulness. Firstly, unlike any mineral, it is inodorous and clean to the fingers, and does not lose any of its weight by usage or wear; it is always transparent, whether in a cold or a red-hot state; it can take any shape whatever while in a state of fusion, and it retains it absolutely after it has cooled. It is capable of receiving the highest polish, and of taking any coloured tint, either on its surface or in its body; and it also has this peculiar and invaluable advantage, that it does not retain any taste of any liquid or acid it may have contained; it is the most flexible of substances while in fusion, and becomes harder than any pure metal when once it has become cold; lastly it is not liable to rust or to be consumed by fire. The innumerable applications of glass are such now, that it is difficult to imagine any one branch of industry or of manufacture which could be carried on a single day without the use of glass in one shape or another. To some of the most important amongst the sciences, such as chemistry, physics, astronomy, the use of glass is a matter of absolute necessity; and in proportion to the gradual and increasing requirement of those last-named sciences, especially astronomy, it will be found that the glass manufacturer has been obliged to perfect his mode of manipulation, and, by the aid of chemistry, has of late years obtained such magnificent results that the field for astronomical observations has thereby been considerably enlarged.—*F. Joubert.*

Substitute for Silver.—Messrs. De Ruolz and De Fontenay have lately obtained, after several years' experiments, a new alloy, which may be very useful for small coin and for many industrial uses. It is composed of one-third silver, 25 to 30 per cent. of nickel, and from 37 to 52 per cent. of copper. Its inventors propose to call it *tiers-argent*, or tri-silver. Its preparation is said to be a triumph of metallurgical science. The three metals, when simply melted together, form a compound which is not homogeneous; and to make the compound perfect, its inventors have been compelled to use phosphorus and certain solvents which they have not yet specified. The alloy thus obtained is at first very brittle; it cannot be hammered or drawn, and lacks those properties which are essential in malleable metals. But after the phosphorus is eliminated, the alloy perfectly resembles a simple metal, and possesses in a very high degree the bualities to which the precious metals own their superiority. In colour it resembles platinum, and is susceptible of a very high polish. It possesses extreme hardness and tenacity. It is ductile, malleable, very easily fused, emits when struck a beautiful sound, is not affected by exposure to the atmosphere, or to any but the most powerful reagents. It is without odour. Its specific gravity is a little less than that of silver. An alloy possessing these properties must be very useful to gold and silversmiths. It can be supplied at a price 40 per cent. less than silver, and its greater hardness will give it a marked superiority. It may also serve as a substitute for gold-plated or silver-plated articles, which are now so common on account of their cheapness, but which will not bear re-plating more than a few times, and which are, in the long run sometimes more expensive than the pure metal. The new alloy, however, will be most useful for small coin. Its preparation and coining are so difficult that the coin made of it cannot easily be counterfeited. Its hardness would render it more durable than silver; and thus the expense of re-coining, and the heavy loss arising from the wearing of our silver coinage, would be greatly diminished.

ANSWERS TO CORRESPONDENTS.

C. Eades.—The tube in which the platinum wires are sealed, should have the air exhausted from it. The points are too close together, they should be eight or ten inches apart at least, and must be connected with the poles of a powerful induction apparatus. The price of a good apparatus of this sort (called a Rhumkorff's coil) is very high. Probably, with the necessary batteries, one to answer your purpose would not cost less than 20*l*. You will obtain a better light by using charcoal points. The induced current does not give so strong a light. You can get American books of Samson Low, Ludgate Hill.

A Lady.—The subject of the crystallization of quartz is one of great interest to the chemist. We shall be glad to hear further particulars.

Dyeing Mixed Fabrics.—A correspondent is anxious to know how to dye a mixture of silk, or wool and cotton, with Magenta.

Solid Chloride of Manganese.—A correspondent writes:—"Can any of your readers inform me where to obtain a quantity of solid chloride of manganese? I am aware it is made in large quantity as a waste product, but cannot ascertain where, or at what cost it may be procured."

A Subscriber.—The *Journal of the Royal Institution* is not now in existence. The *Journal of the Chemical Society* appears every quarter, and the Philosophical *Transactions* once or twice a year, according to their bulk. The index to our first Volume is now out of print, and cannot be obtained except by purchasing a bound volume, of which only a few copies remain.

Books Received.—"A Guide to Croft Spa." By Miss D. Wilkinson. Darlington: 1861. "A Manual of Qualitative Analysis." By R. Galloway. Third Edition. London: Churchill. "Proceedings of the American Pharmaceutical Association for 1859." Boston.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Normal Variability of the Properties of Atmospheric Air, by M. HOUZEAU.

THE ravages of certain epidemics, and the diseases which seem to be confined to certain localities have long caused it to be supposed that the air may contain injurious principles, and thus temporarily and at intervals acquire unhealthy properties which it does not possess in its ordinary state. The facts I am now about to communicate to the Academy show that this variability in the properties of the air breathed by human beings is much more frequent than is usually supposed, and that, instead of being exceptional, it may be said to represent the normal condition of the atmosphere.

If two blue litmus test-papers, of the same size, sheltered from rain and sun, are exposed to the air at the same day and hour, it will be observed that in country air they become completely decolorized in three or four days, while the paper retains almost all its colour if exposed, under the same circumstances, to the air of a town. (Comparative observations made at Paris and Montmorency, August 8, 1856, and at Paris and Nanteau, near Nemours, September 3, 1857.) Similar effects are produced if the operation is performed in two places on the same horizontal line, and distant from each other one or two kilomètres only.

This curious chemical reaction is, so to speak, constant both in summer and winter, but its intensity is augmented when the atmosphere is violently agitated, as during tempests and hailstorms, and at the approach of a storm. I think that the attention of agriculturists and physiologists should be directed to this fact, as it shows that plants and animals are differently impressed by the air according to their situation.

The variability of the chemical properties of the air is singularly confirmed by other characters. If the decolorising action of the air is generally less intense in towns than in the open country, its property of permanently reddening blue litmus seems to follow an inverse order. Blue papers, exposed to the air, but sheltered from rain and sun, receive a fast red tint sooner in a town than in the country. In Paris, in 1856, as d'Arcet had remarked in London long ago, this phenomenon was normal in certain streets abutting on the Conservatoire des Arts et Metiers, and it was observed at Rouen in quarters furthest removed from manufactories,—in those parts nearest the hills covered with verdure in summer. It is true that the prevailing winds blow in that direction, and may thus bring with them the smoke of the town. The papers thus reddened preserve their tints when submitted to the action of an air-pump, or when heated in a tube to 100°. The action of the atmospheric acid on the coloured re-agent usually manifests itself forty-eight hours after exposure to the open air. The edges of the paper first become red, and at the end of the third, fourth, or fifth day, the change from blue to red is complete. Generally, when the decolorising phenomenon above mentioned takes place in a town, it is preceded by the reddening of the re-agent; this seems to me very rare in experiments made in the country.

These differences in the properties of atmospheric air, examined at the same moment, and in a somewhat restricted radius, are confirmed, and, at the same time, made more obvious, by another re-agent, litmus paper of a wine-red colour, half of it being iodised. A paper of this kind will often turn very blue in twelve or twenty-four hours, and sometimes even in six in the portion impregnated with neutral iodide of potassium, and exposed in the country, and yet will undergo no alteration, even in a much longer time, if exposed to such air as circulates freely in a town about one kilomètre from the country station. (Rouen and its environs, July 11, 1858; June 6, 1860.) For many reasons, the phenomenon is less surprising when it occurs in localities further apart and situated at different heights, as Paris and the villages of Laqueue, in Brie, and Nanteau, near Nemours (September 3, 1857), and as Rouen and Florence, in Italy, according to the observations which MM. Carina and Silvestri have been kind enough to make with my papers (December 20, 21, and 29, 1860). Furthermore, it has frequently been proved that this difference in the action of the air on the same re-agents is perceptible, even when the papers are only six mètres apart on the same horizontal line, but separated by a house built in a treeless field. Thus, it sometimes happens that demi-iodised litmus placed to the north of a building the blue colour is far more intense than that placed to the south of the same building and at the same height. An exceptional case is very rare, at all events, within my field of observation. A similar result is obtained if the experiment is made at the two extremities of a vertical line. At Rouen, blue litmus became more thoroughly decolorised, and demi-iodised litmus became bluer at the summit of the cathedral than at six inches from its base, &c.—*Comptes-Rendus.*

On White Lead, by A. ADRIANI, *M.D., Ph.D., F.R.N.I.F., &c., &c., Analytical Chemist and Lecturer at Edinburgh.*

SOME time back I had occasion to analyse a sample of white-lead paint supplied by a most respectable firm, which sample I found to contain 21·9 per cent. of sulphate of baryta. Doubting whether the sample given me was really made by the firm it was said to have been supplied from, I obtained a small keg filled with the paint, and marked by the firm as being white-lead paint of first quality, which paint I found on examination to be identical in composition with the previous sample, containing fully 22 per cent. of sulphate of baryta. It therefore appears, that with the practice of mixing the

white lead with linseed oil, that of adulteration is keeping pace, it being a well-known fact, that the detection is rendered somewhat more difficult when, instead of being sold as a white dry powder, white lead is sold in the shape of a thick paste.

I take leave to quote here the composition of twenty-seven samples of white lead, as made in different manufactories of the kingdom of the Netherlands, and analysed within the last six years by Dr. Vlaandern,[1] assistant to Professor Mulder at Utrecht. The hygroscopic water was not separately estimated.

	I.	II.		Calculated.		Equivalent.
CO_2	11·4	11·4	CO_2	11·4	=	2
HO	2·3	2·4	HO	2·3	=	1
PbO	86·4	86·5	PbO	86·3	=	3

or PbO, HO + 2 CO_2, PbO.

	III.	IV.	V.	VI.	VII.	VIII.
CO_2	12·4	12·2	12·0	12·4	12·0	12·3
HO	2·0	2·1	2·0	2·1	2·0	2·1
PbO	85·0	85·6	85·9	85·7	86·1	85·4

	IX.	X.	XI.	XII.
CO_2	12·3	12·0	12·3	12·2
HO	2·3	1·8	2·1	2·0
PbO	85·5	85·6	85·5	85·6

	Calculated.		Equivalent.
CO_2	12·2	=	5
HO	2·0	=	2
PbO	85·8	=	7

or 2 PbO, HO + 5 CO_2, PbO.

	XIII.	XIV.	XV.	XVI.	XVII.
CO_2	12·7	12·7	12·5	12·7	12·5
HO	2·3	1·7	2·1	1·9	1·9
PbO	85·2	85·5	85·8	85·4	85·7

	XVIII.	XIX.
CO_2	12·9	12·9
HO	2·2	2·1
PbO	85·3	85·4

	Calculated.		Equivalent.
CO_2	12·7	=	3
HO	1·7	=	1
PbO	85·6	=	4

or PbO, HO + 3 CO_2, PbO.

	XX.	XXI.	XXII.	XXIII.	XXIV.
CO_2	13·1	13·5	13·5	13·2	13·0
HO	2·0	1·5	1·6	1·7	1·8
PbO	85·4	84·7	84·9	85·2	85·2

	XXV.	XXVI.	XXVII.
CO_2	13·3	13·2	13·1
HO	1·8	1·9	2·0
PbO	85·1	85·0	85·1

	Calculated.		Equivalent.
CO_2	13·4	=	4
HO	1·4	=	1
PbO	85·2	=	5

The larger quantity of water is no doubt due to hygroscopical water. Two only of the samples of white lead examined have the following composition :—

PbO, HO + 2 CO_2 PbO.

Ten gave this :—2 PbO, HO + 5 CO_2, PbO.
Seven gave this :—PbO, HO + 3 CO_2, PbO.
Eight gave this :—PbO, HO + 4 CO_2, PbO.

Dutch white lead, therefore, consists of 1 equivalent of hydrated oxide of lead, with 2, 2½, 3, and 4 equivalents of neutral carbonate of oxide of lead; 2 and 3 occur more rarely, but 2½ and 4 are usual.

The results here quoted are published by Professor Mulder in a Dutch work, containing the results of researches made in his laboratory. In order that it should not be supposed that the samples analysed were select samples, Professor Mulder distinctly states, that he was sorry he could not find from what manufactories the samples had been obtained, so that he could not make sure of another interesting point, viz., whether in the same manufactory the white lead was always obtained of the same composition. The quantity of hydrated oxide of lead which occurs along with the carbonate of lead is by no means unimportant. At the desire of the party for whom I made the analysis above referred to, I do not publish the name of the firm who supplied the white lead directly. I made three analyses of the sample, and found that the carbonate of oxide of lead and the hydrate of the oxide of lead only amounted to about 60·5 per cent., the remainder being the sulphate of baryta and the oil. Neither chalk, nor sulphates of lime or baryta are found in the Netherlands, unless it be in small quantity in the soils: these articles, as far as wanted, are imported from abroad.

[1] Now, and for some time since, in the island of Java, as Chemist to the Colonial Government.

Rubidium and Cæsium.

According to a communication made by MM. Bunsen and Kirchhoff to Professor Redtenbacher, both rubidium and cæsium, the two alkali metals recently discovered by means of spectrum analysis, have a great chemical similarity to potassium, differing from this metal and from each other in the degree of solubility of their double chlorides of platinum and potassium. At the boiling point, 1000 parts of water dissolve 49 parts of chloride of platinum and potassium, 6 parts of that of rubidium, and 3½ parts of that of cæsium. Rubidium is found in largest quantities in the lepidolite from Rozna (in Moravia), and with traces of cæsium in certain saline mother-liquors. Cæsium seems essentially confined to mineral waters, 39,600 litres of that of Düxhheim yielding 6 grammes of chloride of cæsium.

TECHNICAL CHEMISTRY.

Destructive Action of Minium on the Hulls of Iron Ships. Letter from M. Jouvin *to M.* Dumas.

The observations I made last March on the iron hull of the imperial packet *Guienne*, are confirmed in every point by those furnished by the hull of the packet *Le Bearn*. At first sight there was such strong resemblance between the state of the two hulls, that they seemed identical; but by going into details the following differences were observed :—

The whole of the hull of *Le Bearn*, which has received a coating of minium, has become dull red; the vivid tint of oxide of lead is extinguished in a vague colour as if washed out; or as if the painting had been covered with a sort of grey glazing. On this ground scales of hydrated oxide of iron stand out in relief, and are just as numerous and large as in the case of the other vessel. On this occasion I found that the layer of oxide of iron was much thicker at the corners and edges of the sheet iron plates than elsewhere, although the friction must be greater on these prominent parts. This fact escaped my notice with the hull of the *Guienne*.

I think the bubbles are as numerous on the rest of the coat, if not so large as on the *Guienne*. These bubbles may be always divided into two kinds :—

1. Bubbles containing some drops of liquid.

2. Bubbles without liquid, and containing merely air or a gas.

The latter are remarkable for being covered at their base with minute crystals of lead, overlaid with a thin coating of hydrated oxide of iron or yellow ochre. The internal surface of the pellicle of which they are composed, examined with a lens, shows needles of chloride of lead in the midst of slight concretions, which have the appearance of "horn lead" of mineralogists. (*Kéraisne.*)

The concretions of chloride of lead, which I found afterwards at the base of both kinds of bubbles, on the iron hull, imbedded in magnetic oxide of iron, the dark colour of which they relieve by their slightly amber tint.

The liquid contained in the other bubbles I have subjected to a more careful examination. Tested *in situ* it slightly reddens litmus paper. To the taste at first it is freely styptic and rough, a taste due to the ferrous chloride, as I said in my first paper; to this soon succeeds a sweetish taste, resembling a weak solution of acetate of lead. In my observations on the *Guienne* I recognised, by this taste, the presence of a dissolved salt of lead in the liquid contained in the bubbles. I did not mention it at the time, because I had not determined its nature.

In order to find out, I collected a certain quantity of the liquid by absorbing it with a piece of blotting-paper, when it became easy, by means of distilled water and re-agents, to determine that the liquid consisted of a solution of ferrous and flambic chlorides. Do not these two chlorides form a true soluble saline combination? I am strongly inclined to this opinion. When occasion serves, I propose to revert hereafter to this study. One fact which my experience has taught me is, that solutions of ferrous chloride become, by contact with minium, charged with chloride of lead, as may have been easily foreseen.

The liquid of the bubbles, when exposed to air, quickly becomes covered with a thin pellicle of sesquioxide of iron, without precipitating the slightest trace of chloride of lead. This salt does not appear until only a trace of liquid remains at the bottom of the capsule. By means of the microscope, and even with a lens, it is easy to detect in the midst of the sesquioxide of iron the play of colours of the micaceous spangles of this salt, the deposit of which in the capsule seems to me to be effected in the same manner as if the bubbles were dried.

There was a degree of regularity in the disposition of the concretions on the hull of the *Guienne* which was not to be found on that of *Le Bearn*. In other respects it presents exactly the same foliated structure; it has always externally and at the moment of immersion the same gray colour of the iron; then, under this thin envelope, yellow ochre; and at the base the dark green of hydrated ferrous oxide and ferroso-ferric oxides. In all these points the concretions on the two vessels were almost identical. We shall likewise soon establish their chemical identity.

To conclude. Two chemical experiments on a very large scale have been originated in the workshops of La Ciotat. 1200 square mètres of sheet iron, covered with linseed oil, and mixed with minium for the first layer, and the same preparation, with the addition of mercuric sulphate (7·5 per cent.), for the second layer, have been launched on the sea; that is to say, that, endowed with a positive electrical polarity (for the hold itself is also painted with minium), this gigantic electrical pair, forming at the same time a kind of condenser, has been plunged into a solution of alkaline chlorides saturated with air. It has then made two or three voyages to Brazil, touching successively at Lisbon, St. Vincent, Pernambuco, and Bahia, to go into port according to circumstances, either at Rio or Bordeaux. During these long voyages this hull, besides the friction of the water and the shock of the waves, has undergone great inequalities of temperature, which must have caused prodigious dilatations in its metallic sides.

We have now before us the results of these two experiments:—

1. A considerable quantity of oxides of iron (ferroso-ferric oxide predominating) either in concretions or pulverulent.
2. Ferrous chloride.
3. Plumbic chloride.
4. Metallic lead.

Chemical analysis has not hitherto enabled me to discover more than this, either in the concretions or bubbles, besides, of course, minium and the oily menstruum.

The following is the mean of ten analyses made by the same process and under the same conditions:—

	Concretions of the *Guienne*.	Concretions of *Le Bearn*.
Sesquioxide of iron	72·45	70·54
Ferrous chloride	2·85	2·86
Plumbic chloride dissolved by ferrous chloride	2·80	2·52
Oxide of lead mixed with chloride	7·30	4·95
Alkaline chlorides	0·87	1·42
Organic matter	3·73	4·99
Water	10·00	12·72
	100·00	100·00

What has become of the mercuric sulphate? Hitherto I have failed to discover any traces of it. The transformation undergone by this salt by reason of the oil with which it is mixed, will be made the subject of another paper.—*Comptes-Rendus.*

On the Origin and Progress of the Phosphorus and Match Manufactures, by G. Gore.

(*Continued from page* 32.)

This wet and finely-divided substance having been dried, sifted, and packed in air-tight tins, is ready for sale.

It is well known in modern chemistry that a substance may exist in two or more physical states, possessing very different physical and chemical properties, and that there may be as great a difference in the properties of the same substance in its different states of aggregation as there is between two chemically different substances. For instance, there is as great an amount of physical difference between carbon as it exists in the diamond and as it exists in pure lamp-black as between copper and silver or silver and gold. The two kinds of phosphorus we have described are, then, precisely the same chemical substance, but in different states of aggregation. The following is a comparison of their properties. We will, for convenience, term them white and red phosphorus:—

White.	Red.
Poisonous.	Innocuous.
Evolves a strong odour.	Nearly odourless.
Phosphorescent—luminous in the dark.	Not phosphorescent—perfectly illuminous.
Melts at 108° F.	Melts at above 500° F.
Very transparent.	Opaque.

White.	Red.
Almost colourless.	Varies in colour from nearly black (with metallic lustre) to iron-gray, brick-red, crimson, and scarlet.
Freely soluble in various liquids.	Nearly insoluble in all liquids.
Distinctly crystalline.	Destitute of all crystalline structure (amorphous).
Soft, may be indented by the nail.	Hard as a common red brick.
Flexible as copper or lead.	Brittle as glass.

The great and most conspicuous fact is that red phosphorus may be kept in the dry state, exposed to the air, without inflaming; whilst the ordinary variety, under the same circumstances, quickly ignites. The minutest quantity of ordinary phosphorus in the red or amorphous variety can be detected by digesting the latter, in the state of powder, in bisulphide of carbon, and then letting fall a single drop of the clear liquid upon a saucer floating upon boiling water in a dark place; luminosity will immediately appear if white phosphorus is present.

There are several uses to which phosphorus has been applied, but, as far as quantity is concerned, almost the only important application is in the manufacture of lucifer matches. It is remarkable that, although the property of phosphorus of igniting by friction was known soon after its discovery, it was not until about the year 1833 that it was successfully applied to the manufacture of matches. It was then sold wholesale at four guineas a pound; in 1837, at two guineas; and at the present time, at less than half-a-crown. Manufactories of it exist in Great Britain, France (Lyons), Bavaria, Baden, Austria, and Sardinia.

Since the commencement of the manufacture of phosphorus upon a large scale in England, in 1845, the value of phosphorus imported into this country has regularly and rapidly decreased. According to the reports of the Great Exhibition of 1851, the value of phosphorus imported from all parts into Great Britain in 1844 was 2567*l*., and in 1850 only 3*l*. And since that period it has become an article of constant export to the Continent and other parts, the proportion consumed in the United Kingdom being comparatively small. In his "Cathechism of Agricultural Chemistry," Professor Johnston states that 200,000lbs. of phosphorus are consumed in London alone per annum. Persons conversant with the actual consumption know that at that time, and probably at the present hour, it would not exceed 20,000lbs.

It is also stated in a recent publication on Chemistry, by Professor Muspratt, (article "Phosphorus," p. 680,) that phosphorus "is prepared as an article of manufacture in large quantity in London and Paris. Kane has calculated that in the latter city alone about 200,000 lbs. are yearly produced." There may have been once a very small production in London and Paris, but it has long since entirely ceased. The enormous consumption of fuel necessitates that, for an economic production, the manufactory be placed where coal is cheaply obtained; and the quantity of phosphorus produced in all France, at the date of Dr. Kane's book, is not likely to have been at all more than 20,000 lbs. It is plain that, by mistake, a cypher too many has been added.

Reserving a few remarks upon the importance of the labours of Brandt, Boyle, and others who investigated phosphorus, until the close of this article, I will now give a brief account of the gradual development and present condition of the lucifer match manufacture.

The earliest recorded means of obtaining a light appears to have been by means of rubbing together two dry sticks. A hole having been made, by means of a sharp stone, in a dry piece of wood, and, by the same means, a piece of stick of different wood—laurel with ivy for instance—having been cut to a point at one end, the sharp point was inserted in the hollow, and rapid rotation imparted to it by means of the hands, similar to the motion of a chocolate stirrer, until, in a few minutes, the friction of the point generated sparks, from which a fire was obtained. Sulphured matches are also of very ancient origin.

The next method—that of the common flint and steel—was in use for centuries, and can even now be remembered by every adult person. It consisted in striking the edge of a small piece of flint against the edge of a rod of iron or hardened steel, in such a direction that the sparks which occurred fell upon pieces of tinder (charred linen), contained in a shallow tin vessel, and ignited them. By gently blowing the ignited tinder, the combustion spread and became sufficient to inflame a sulphured match. If the tinder was at all damp, it failed to ignite.

The discovery of phosphorus in 1669, with its luminous and igniting properties, at once indicated the possibility of using it to obtain a light; but no successful experiments of the kind at that period have been recorded. It was not until 1833 that it was successfully applied. In the meantime, a number of inventions for obtaining a light, some involving the use of phosphorus and others not, were adopted to a limited extent. Phosphoric tapers, consisting of ordinary wax tapers, with their wicks coated with phosphorus, and enclosed in air-tight glass tubes, were for some time in use. To obtain a light with them, the end of the glass tube was broken off, and the phosphorus, now exposed to the air, oxidised quickly and inflamed.

The next plan consisted of a well-corked bottle, coated internally with phosphorus; a sulphur match was introduced into it, and a little of the phosphorus adhering to the top of the match, caused the sulphur to inflame on coming into contact with the air. If it failed to ignite, the action was assisted by rubbing the match upon the cork of the bottle.

Homberg's pyrophorus, or fire-bearer, consisted of a dried and roasted mixture of three parts of alum and two parts of flour or sugar contained in a well-closed bottle. A little of this powder exposed to the air upon cotton wool ignited the cotton. This mixture contained no phosphorus. There were several other mixtures of a similar kind by Gay Lussac, Dr. Hare, and others, but they were only used by the curious and scientific.

The "inflammable air-lamp" of Volta consisted of a stout glass vessel containing zinc and diluted oil of vitriol. Hydrogen gas was generated by these substances, and on turning a cock the issuing jet of gas was ignited by an ingenious contrivance, consisting of an electrophorus, which passed an electric spark through it at the moment.

The "light syringe" consisted of a vertical brass cylinder and piston, with a small piece of tinder placed inside at the bottom and closed end. On compressing the piston very rapidly and with great force, heat was evolved by the condensation of the air and ignited the tinder, which was then removed by various contrivances.

In 1804, a little bottle, containing a mixture of phosphorus, oil, and wax came into use. A sulphur match

was dipped into the composition and then ignited by rubbing it upon the cork of the bottle. This was succeeded by a similar bottle of composition, with matches tipped with a mixture of sulphur and chlorate of potash.

In 1807, the "chemical matches," composed of sulphur matches tipped with a mixture of chlorate of potash, sugar, gum, vermilion, and sometimes camphor, were invented. They were ignited by dipping them into a bottle containing asbestos fibre moistened with sulphuric acid.

About the year 1820, Döberiener discovered that finely-divided platinum has the property of causing a mixture of oxygen and hydrogen gases to unite and inflame, and invented his well-known hydrogen lamp. This consisted of an apparatus somewhat similar to Volta's for generating hydrogen by means of zinc and diluted sulphuric acid in a strong glass vessel. On turning a small tap a jet of the gas issued forth and impinged upon a small ball of the platinum powder which immediately became red-hot and ignited it; from this a taper was lighted. By a peculiar mechanical contrivance in this apparatus, when the gas issued from the orifice, the acid and water came in contact with the zinc and generated a fresh supply of gas; and as soon as the tap was closed and a sufficient stock of the gas was produced, the liquid was expelled by the gas from contact with the zinc, and the generation of gas ceased.

In 1826 "lucifers," or light-bearing matches, were invented. They consisted of ordinary sulphur matches, tipped with a composition of chlorate of potash and sulphuret of antimony, and were ignited by drawing them briskly between folded glass-paper. The defect of these was that they required a considerable effort to ignite them, and the composition was apt to be torn off by the violence of the friction.

These were succeeded in 1828 by the "Prometheans," consisting of a small roll of gummed paper, containing at one end a dried paste of sugar, chlorate of potash, gum, and water, together with a small bulb of glass containing oil of vitriol. They were ignited by means of a small pair of pliers supplied with the box of matches.

In 1830, bottles, containing a mixture of one part of manganese and two parts of phosphorus, were patented for producing a light. Into these bottles common sulphur matches were dipped, and ignited by oxidation of the phosphorus on exposure to the air.

All these inventions failed in superseding the old-fashioned tinder-box with its flint and steel, chiefly on account of their greater expense, but also on account of their dangerous and uncertain action. About the year 1833 phosphorus was at last successfully introduced into match composition, and from that period the tinder-box rapidly declined in use, and the new matches became a successful and extensive branch of manufacture.

The phosphorus match did not, however, at once acquire the degree of perfection it now possesses. A variety of substances were tried in the preparation of the match-splints and in the composition of the inflammable paste: vegetable wax, bees' wax, sulphur, stearine, oil, and fat to make the wood ignite; glue, gum, and sugar to make the mixture adhere; chlorate of potash, saltpetre, sulphur, sulphuret of antimony, antimonial saffron, red lead, and peroxide of manganese to increase the combustibility; powders of charcoal, cork, pitch, resin, magnesia, lime, or chalk, to make the composition more porous; powdered glass, sand, or emery to increase the friction; and vermilion, red lead, red ochre, Prussian blue, smalts, ultramarine, or chromate of lead, as a colouring matter, and to disguise the other ingredients.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Caffein as an Antidote to the Poisonous Effects of Opium.

Professor Henry Fraser Campbell, of Georgia, in the *Southern Medical and Surgical Journal*, publishes an article on this subject. After giving some account of caffein, and the use of coffee as an excitant, he describes the patient as a young man, 24 years old, who had, in a fit of mental depression, swallowed an ounce and a-half of laudanum, nearly an hour before his visit, 8 p.m. Narcotism had proceeded so far that emetics could not be employed; the muscles were greatly relaxed, the tongue falling back in the mouth and tending to stop respiration, and respiration exceedingly feeble. Cold water was applied to the head for a time, artificial respiration resorted to, and the stomach-pump then vigorously applied. At twelve o'clock the same night the case seemed more hopeless, respirations but four to the minute. Artificial respiration in a sitting posture was then resorted to, which seemed to have a temporary good effect. Dr. Campbell then thought of coffee, but the patient could not swallow, and he doubted the propriety of using the stomach tube in the then condition of the patient. Finding it difficult to get a strong infusion of coffee, the idea of employing caffein occurred, and having dissolved 20 grains in a quantity of infusion of coffee, it was administered as an injection by means of a syringe. In half-an-hour the respirations were eight per minute; an hour had not elapsed before he "forcibly jerked his left arm from the assistant," and told them "to let him alone." The narcotism slowly passed off, and at ten o'clock next day, when Dr. Campbell called, the patient had left the hotel and gone home. Although the effects of the narcotism were apparent for several days, they soon wore off, and the patient entirely recovered. Dr. Campbell believes that the caffein in this case was largely concerned in the recovery, and points to that alkaloid as probably possessing valuable antidotal powers in cases of narcotic poisoning from this drug.

On the Alkaloid and other Constituents of Coca Leaves, by Dr. A. Niemann.

The inaugural dissertation of the author is published in *Wittstein's V. Schrift.*, ix. 489—524. It contains many interesting facts, but is too lengthy for translation; we therefore give in the following a condensed account of it.

After discussing the importance of the vegetable alkaloids in a medicinal point of view, and for the examination of crude drugs, the author disapproves of such incomplete investigations as enrich our knowledge with nothing else but names, and then considers the interest attached to those stimulating vegetables denominated by Von Bibra "narcotic victuals," like coffee, tea, cacao, and tobacco. The coca leaves are employed for similar purposes by the natives of Peru and Bolivia.

The Austrian frigate *Novara* brought from Lima a quantity of good coca leaves, which Professor Wöhler handed to the author for investigation.

After treating at length of the botanical characteristics of the order *Erythroxylaceæ*, which comprises only the genus *Erythroxylon*, and its geographical extension, he gives a minute description of *E. coca*, its culture, and the use and properties of its leaves, referring to the observations and opinions of Von Martius, Poeppig, Von Tschudi, Weddell, and Scherzer, some of whom have

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advocated the introduction of the coca into the European navies and armies on account of its well-known qualities to preserve life and strength for a considerable time without food.

The author reviews the various incomplete investigations of Wackenroder, Johnston, Gaedcke, and Maclagan, and states that the alkaloid prepared by Pizzi, of La Paz, and brought by Tschudi to Europe, was analysed by him and found to be gypsum.

The following is the author's process for preparing the alkaloid, which he proposes to name *cocaina*:—The leaves are exhausted with 85 per cent. alcohol, containing $\frac{1}{50}$th sulphuric acid, the tincture treated with milk of lime, the filtrate neutralised with sulphuric acid, and the alcohol regained from the filtrate by distillation. The syrupy residue is treated with water to separate resin, the liquid is precipitated by carbonate of soda, when an odour reminding of nicotine is emitted, and the alkaloid is exhausted by repeated agitation with ether, distilling off most of the ether, and evaporating the residue spontaneously. The yield is about $\frac{1}{4}$ per cent of crude cocaina, consisting of colourless crystals mechanically mixed with a yellowish-brown matter, of a disagreeable, almost narcotic odour, which cannot be removed by animal charcoal or re-crystallisation, but may be separated by washing with cold alcohol. Less loss is sustained if the ethereal solution is agitated with diluted sulphuric acid, the aqueous solution of the sulphate precipitated by carbonate of soda, and the precipitate freed from the last traces of colouring matter by alcohol. The alkaloid crystallises best on evaporating spontaneously an alcoholic solution previously diluted with water.

Pure cocaina is in colourless, transparent, rather large prisms, inodorous, soluble in 704 parts water, at 12° C. (53·6° F.), more in alcohol, freely in ether. The solutions have an alkaline reaction, a bitterish taste, promote the flow of the saliva, and leave upon the tongue a peculiar numbness, followed by a sensation of cold. The crystals fuse at 98° C. (208° F.), and congeal again to a transparent mass, which gradually assumes a crystalline structure. Heated above its fusing point it becomes coloured and is decomposed. It runs up the sides of the vessel, and it is uncertain yet whether a small portion will sublime unaltered. It fuses upon platinum foil, and burns with a bright flame, leaving a charcoal, burning with some difficulty.

No physiological experiments have as yet been made with it.

The alkaloid is readily soluble in all diluted acids, forming salts which are of a more intensely bitter taste than uncombined cocaina. It absorbs dry hydrochloric acid gas, fuses and congeals to a grayish-white transparent mass, which crystallises after some days; the solution crystallises in long, tender, radiating crystals. The sulphate and nitrate dry to an amorphous, colourless mass, which gradually changes to crystals, the latter with great difficulty. The acetate readily assumes the form of a crystalline, sometimes herbaceous-looking mass.

The following is the behaviour of a diluted solution of the hydrochlorate to re-agents:—

Fixed alkalies: a white precipitate, slowly soluble in a large excess.

Ammonia and carbonate of ammonia: the same precipitate, readily soluble in excess.

Carbonate of soda: white precipitate, insoluble in excess, becoming crystalline.

Sulphocyanide of potassium: a slight turbidity.

Protochloride of tin: a white, curdy precipitate, soluble in much nitric acid.

Picric acid: a pulverulent, sulphur-yellow precipitate, becoming resinous.

Terchloride of gold, even in the most diluted solutions: a voluminous, light-yellow precipitate, becoming flocculent, soluble in the heated mother-liquor, and crystallising on cooling in beautiful yellow scales, resembling iodoform; it crystallises from hot alcohol in golden yellow scales or in a dense granular powder.

Bichloride of platinum: a dirty, grayish-yellow precipitate, becoming crystalline, soluble on heating, scarcely soluble in muriatic acid.

Tannin: a very slight turbidity; in the presence of muriatic acid a voluminous, pearly-white precipitate, shrinking and becoming resinous in appearance.

Bichloride of mercury: a voluminous, soon flocculent precipitate, soluble in muriatic acid and in chloride of ammonia. It does not crystallise from its solution in alcohol.

Iodo-hydrargyrate of potassium: a curdy-white precipitate, soluble in muriatic acid and chloride of ammonium.

Molybdate of ammonia in the most dilute solutions: a voluminous, yellowish-white precipitate.

Iodine: a kermes-brown precipitate.

Iodide of potassium: scarcely a faint turbidity; when containing iodine a strong brownish-red precipitate, which darkens gradually.

Tincture of iodine: no turbidity in the alcoholic solution of cocaina. No reactions were obtained with phosphate of soda, bicarbonate of potassa, tartar emetic, acetate and subacetate of lead, sesquichloride of iron, and iodic acid.

Cocaina is dissolved by fuming nitric and by concentrated nitric, hydrochloric, and sulphuric acids, without colouration; when heated, only the latter darkens and ultimately blackens it. A characteristic test with oxidising agents has not been observed. In its chemical and also physical properties, it resembles atropia to some extent.

The atomic weight of the alkaloid was determined from the double salt with chloride of gold, and was found from the amorphous compound = 283, crystallised from hot water = 280, crystallised from alcohol = 288. On heating the dry double salt, a sublimation of benzoic acid took place, the first observation of the kind of any known alkaloid. Ultimate analysis showed the following composition:—

	I.	II.	Calculation.		
C	66·8	66·8	C 32	192	66·20
H	7·1	7·5	H 20	20	6·90
N	5·4	5·4	N	14	4·83
O	20·7	20·3	O 8	64	22·07
	100·0	100·0	$C_{32}H_{20}NO_8$	290	100·00

Vegetable Wax from Coca Leaves.—The precipitate occasioned by milk of lime in the alcoholic tincture was treated with cold ether, which, on evaporation, left a soft, sticky, brown mass, wholly soluble in boiling alcohol, from which, on cooling, a white body was separated, appearing, after repeated solution in hot alcohol, as a snow-white, granular mass. It fuses at 70° C. (167° F.), is slowly soluble in hot alcohol, readily in ether, and is not acted on by solutions of alkalies or acids. By elementary analysis 80·2 C., 13·4 H., and 6·4 O. were obtained, which leads to the empirical formula, $C_{66}H_{66}O_4$. The composition of this body, called coca wax by the author, closely corresponds with that of Mulder's grass wax and syringa wax.

Cocatannic Acid.—After precipitating the cocaina by carbonate of soda, as above, the dark red filtrate is freed from ether, neutralised by nitric acid, the sulphuric acid removed by nitrate of baryta, the excess of the latter by carbonate of ammonia, and the liquid neutralised by nitric acid; acetate of lead now produced a voluminous, dirty brownish-green precipitate, which was decomposed by sulphuretted hydrogen, and yielded a clear, yellowish-red solution, of slightly astringent taste, reddening litmus, and giving the following reactions:—Alkalies and their carbonates, a deep red colour; sesquichloride of iron, a dark-brownish yellow colour; glue and bichloride of mercury, no turbidity; the nitrates of mercury, dirty yellow precipitates, soluble in acids; tartar emetic, a flocculent, brownish-yellow precipitate; albumen, dirty yellow; acetate of baryta and lead, dirty yellow, soluble in acetic acid; terchloride of gold, dark brown precipitate, soon after a mirror of metallic gold; nitrate of silver, a turbidity, on heating a dirty yellow precipitate, afterwards a dark brown powder; hydrochlorate of cocaina, no turbidity. The tannin solution reduced chromate of potassa, and on boiling, also, Fehling's solution of copper; it dried on evaporation to a transparent brownish-red mass, containing some inorganic matter.

The filtrate from the precipitate with acetate of lead yielded with subacetate of lead, a yolk-yellow precipitate, apparently containing the same tannin, partly modified through the influence of the nitric acid.

Odorous Principle.—On distilling 100 grammes of the leaves, a slightly turbid distillate was obtained, which, on re-distilling it with chloride of sodium, yielded white globular masses, lighter than water, and possessing the peculiar, tea-like, strong odour of the leaves. The quantity was insufficient for further analysis.

PHYSICAL SCIENCE.

Some Observations on the Sensibility of the Eye to Colour,[1] *by* John Z. Laurence, *F.R.C.S., M.B. Lond., Surgeon to the South London Ophthalmic Hospital.*

If, closing one eye—say the right—any highly luminous white ground, such as some portions of the sky on a sunny day, is viewed with the left through a dark tube, so as to exclude all extraneous light, after a little the eye will begin to feel fatigued, and a librating circular smoky spectrum will be perceived at the end of the tube. When the tube is laid aside and both eyes are directed to the sky, a similar spectrum will be observed, projected, as it were, on the surface of the heavens, but much darker. But if after a time each eye is alternately opened and closed, a rose-coloured spectrum is seen with the left eye, a pale-green one with the right. These appearances are seen still better if, instead of the sky, a white screen is used as the plane of projection in the second part of the experiment. At first an almost black circular disc is seen; this becomes lighter and lighter, till it is finally succeeded in the left eye by a bright rose-colour disc, surrounded by a violet border; in the right eye by an equally bright green, with a rose border. These spectra sometimes appear as if upon the surface of the screen, sometimes, on the contrary, as if originating within the eyeball itself, and indeed may be even seen with both eyes closed. To see the above phenomena in all their intensity, a slightly different plan must be adopted. As the field of projection, a sheet of dead black paper in a dark room is to be used; the spectra then seen with either eye are the same, and their colours most splendid, both as regards brightness and tint. At first an emerald-green disc appears, surrounded by a narrow carmine, or, perhaps, more accurately, magenta border; the magenta tint is then seen to encroach more and more upon the green, till the whole disc is of the former colour, surrounded by a bluish-violet border; this last, in its turn, invades the magenta, till the final spectrum is of one uniform indigo-violet colour.

The above is the general sequence of colours which I, and other persons whom I have asked to perform the experiment, have observed; but these are liable to exceptions. Occasionally, the librating spectrum observed at the end of the tube in the first part of the experiment, acquires a faint rose, green, or violet tint. Sometimes, I have seen the spectra of the right and left eyes, in the second part of the experiment, reversed as regards colour.

These facts appear to prove the following propositions:—

1. That colour sensations may be excited in the retina, or brain, altogether independently of any external colour-stimulus.

2. That as an optical analysis of white light may be effected by a prism, so with the eye we possess the power of effecting, what may be called, its physiological analysis.

3. The last proposition tends to the conclusion that white light consists of three fundamental colours—magenta, emerald-green, and indigo-violet—corroborating in a remarkable manner the opinions of Professor Maxwell and Dr. Young on the same subject.

4. That a colour sensation excited in one eye is generally felt in the other, although this latter has not been exposed to the influence of light in any part of the experiment; that, in a word, a very close sympathy exists in the two retinæ, of which the consentaneous action of the two irides is probably but a reflex nervous consequence.

I may here allude to a distinction in ocular spectra, which has, I believe, not been taken much account of by observers of these phenomena. Some spectra seem as if projected on the plane to which we direct the eye, and in that case appear, as I have found from numerous measurements, linearly magnified in proportion to the distance of the eye from the plane of projection. Other spectra, on the contrary, are perceived, so to say, in the eyeball itself, and are of a subjective nature. Independent of the differences of their apparent seats, the two classes of spectra present certain other well-defined distinctions. Projected spectra are only perceived with the eyes open, and are generally but faint in colour; while subjective ones may be seen with the eyes shut, and are always intense in colour. At the same time I am disposed to ascribe the differences of colour, in a certain degree, to the diluting influence of extraneous light; for projected spectra are always seen more vivid in a dark room than in daylight.

The green spectrum observed on a sheet of white paper, after prolonged contemplation of a red wafer, has been commonly explained thus—"When the eye has been for some time fixed on the red wafer, the part of

[1] Since writing this paper, my attention has been directed to a series of elaborate disquisitions by Brücke and Fechner in Poggendorf's *Annalen der Physik u. Chemie*, vols. lxxxiv., l., and xliv. to which I beg to refer my readers.

the retina occupied by the red image is deadened by its continued action, and insensible to the red rays which form part of the white light from the paper; consequently will see the paper of that colour which arises from all the rays in the white light of the paper, but the red; that is, of a bluish-green colour, which is therefore the true complementary colour of the red wafer." [2]

That this explanation is not correct seems to me to be proved by the following experiment:—

I, at night, made a room (which is provided with thick American-leather blinds for ophthalmoscopic purposes), to all appearances, absolutely dark, then viewed with the left eye a small aperture in a dark box, covered with a piece of emerald-green glass, behind which was the nearly white flame of a lamp. The right eye was kept closed, and covered with a thick handkerchief. After a time I blew out the light in the box, and looked at a screen covered with a sheet of dead-black paper. With the left eye a large carmine-coloured projected spectrum of the flame could be seen; with the right eye I generally perceived no spectrum at all, or if any, but of a very faint tint. But, if the latter eye was exposed to a white light during the first part of the experiment, I invariably perceived the same spectrum with this eye as I did with the left one.

This experiment shows that the presence of white light is not necessary for the perception of complementary ocular spectra, and further would appear to indicate that for a sympathetic spectrum to be excited in the eye which has not been exposed to the colour-stimulus, the excitation of some light is necessary.

M. Plateau painted one half of a piece of paper red, the other green; and after alternately directing the eyes to each half, covered them with a handkerchief, and observed a black image, having on each side a complementary coloured image.[3] He hence inferred that "the combination of accidental colours produces black." Sir D. Brewster very properly objects to this conclusion, "because the eye has been in succession rendered insensible to the two colours which compose white light itself."[4] Elsewhere the same author says, "If we take the two complementary colours, namely, the red and the green tints forming the ordinary and extraordinary pencils in the polarised ring, which, by overlapping, form white light, then it is manifest that the accidental colour of the overlapping part is black, and hence the sum of the action of the red and green acting separately must also be black."[5]

Notwithstanding, however, the authority of Sir D. Brewster, the following experiment which I have performed appears to me rather to corroborate Plateau's view. If the two halves of a card painted red and green respectively, be illuminated by a green or red light, they appear black. In the same way, but depending on a different cause, the two halves of the card, if viewed through green or red glass, appear black.

Another set of observations, connected in a degree with the preceding, may be here noticed. Chevreul[6] distinguishes two chief species of contrast of colours, simultaneous and successive contrasts. But an examination of these distinctions shows them in my judgment to be more apparent than real, and but the expression of one fundamental fact, viz., that the eye on perceiving any one colour acquires a tendency to see its complementary. Thus, to take an example of Chevreul's simultaneous contrast:—If a strip of red and one of yellow paper be viewed side by side, near the line of contact, the red paper inclines to violet, the yellow to green. The rationale of this is at once obvious: the red mingling with the complementary of yellow, *i.e.*, blue, produces the violet tint; whilst the yellow mingling with the complementary of red, *i.e.*, green, produces a light green; and this same law holds good in the juxtaposition of any two colours whatever. By the term successive contrast, Chevreul designates the familiar phenomena of complementary ocular spectra, of which a most comprehensive history has been given by Darwin, in the *Philosophical Transactions*, vol. lxxvi. p. 33, *et seq.* Du Tour[7] thought that the two eyes cannot perceive each a separate colour at once. He says that if, *e.g.*, a blue disc be presented to one eye and a yellow one to the other, the result is that the mind perceives alternately the one or the other colour, but not the two at once. But I would submit that these two statements do not include the whole facts of the case. I took two tubes, each 10½ inches long, and applying the end of one to each eye, viewed the sky through them. I found that when the contiguous edges of the tubes at their further ends were some inches apart, two distinct white circles of sky were seen; these circles touched when the edges of the tubes were from 2½ to 2⅝ inches apart, and, when closer, the two circles appeared as one. If now the further end of one tube was covered with a piece of green glass, the end of the other with a piece of red, as long as the ends of the tubes were kept not closer than 2½ to 2⅝ inches asunder, the two coloured discs were perceived perfectly distinct from one another; no alternation of either colour to the exclusion of the other, as in Du Tour's experiment, ensued, so long as the tubes were inclined to each at this or any greater degree of divergence.

Another very interesting series of phenomena depending on the intrinsic sensibility of the eye to the impressions of colours are those of coloured shadows. The first exact observations on these were made by Count Rumford.[8] He observed that the two shadows of an object placed in front of a white ground, from a white and a coloured light, were of the two colours complementary to the latter. I have investigated this fact a little more closely. The method adopted has been to throw a white and a coloured (red) circle of light from two magic lanterns on a white screen, before which a slender wooden rod was placed. It is easy to satisfy ourselves that the red shadow is produced by the (otherwise colourless) shadow cast from the interception of the white light being simply illuminated by the other red light. The green shadow is the shadow produced by the interception of the red light, illuminated by the white light. These coloured shadows have, by Rumford and many subsequent observers, been ascribed to the effect of contrast. But this appears an inadequate explanation; for if, with one magic lantern, a half-white and a half-red circle of light be thrown on a screen, a shadow thrown across the two fields is simply dark, without any colour at all. If, again, a red and a white disc of light be thrown from two magic lanterns respectively on a screen, so as partially to overlap, where the overlapping

[2] Brewster's "Optics," 1831, p 305.

[3] *Annales de Chimie* for 1833.

[4] London and Edinburgh *Philosophical Magazine* for May, 1839, p. 335.

[5] *Op. Cit.* for December, 1839, p. 437.

[6] "The Principles of Harmony and Contrasts of Colours," by M. E. Chevreul.

[7] "Memoires de Mathématique et de Physique presentés a l'Académie Royale des Sciences," iii. p 514, iv. p. 499; Paris, 1760-63.

[8] "Philosophical Papers," by Benjamin, Count of Rumford London: 1802. Vol. i. p. 333.

takes place two complementary shadows of any object are seen, but in the other two parts of the field only one colourless dark shadow is seen.

The following facts seem to form the basis of the explanation of coloured shadows :—Firstly, the experiment of Rumford,[9] that a piece of gray paper placed next to a piece of coloured paper, both on a black ground, with the exclusion of extraneous light, appears tinged with the complementary colour. Secondly, I found by my own experiments that if, in a dark room, the screen is illuminated with a red circle of light from a magic lantern, the greenness of the shadow and the redness of the ground on which it appears are inversely proportional to one another. By approximating the red light to the screen this becomes redder, whilst the shadow of the rod placed before it becomes less green and darker, till it becomes an ordinary black shadow; that, on the other hand, removing the red light till it leaves the white screen but faintly tinged with red, brings out the green shadow very prominently, and on admission of light into the room, a second faint red shadow comes out.

Meusnier observed, "that when the sun shone through a hole a quarter of an inch in diameter on a red curtain, the image of the luminous spot was green." Another observer, Mr. Smith, of Foehabers,[10] states, "If we hold a narrow strip of white paper vertically, about a foot from the eye, and fix both eyes upon an object at some distance beyond it, so as to see it double, then if we allow the light of the sun, or a light from a candle, to act strongly upon the right eye without affecting the left, which may be easily protected from its influence, the left hand strip of paper will be seen of a bright green colour, and the right hand strip of a red colour."

From all these facts, I think the conclusion arrived at by Sir David Brewster appears highly probable, that "as in acoustics, where every fundamental sound is actually accompanied with its harmonic sound, so in the impressions of light, the sensation of one colour is accompanied by a weaker sensation of its accidental or harmonic colour."[11] To this might perhaps be added that there is a tendency in the eye to, as it were, decompose white light into two complementary colours; and, further, that the predominant decomposition is into red and green.

Applying this theory to the phenomena of coloured (*e. g.*, red and green) shadows, the red shadow has already been shown to be simply due to the illumination of a colourless shadow by a red light; whilst, on the whole of the rest of the field of the white screen, the red tint cast from the magic lantern is sufficiently powerful to overcome the green tint which the eye would otherwise perceive, excepting at one spot,—namely, that which does not receive any red light on account of the interposition of the opaque rod. Here the green (harmonic) colour, having no antagonistic red to overcome it, is rendered sensible to the eye.

An Old Cathartic Revived.—The leaves of the *Globularia Alyssum*, which were known in the middle ages as a purgative, have been recently re-introduced by Dr. Planchon, of Montpelier, who claims for them that they are efficient as a purgative, without producing nausea or griping, and that their bitter properties give them a tonic action.

[9] *Op. Cit.*, p. 336.

[10] Brewster's "Optics," p. 405; *London and Edinburgh Philosophical Magazine* for October, 1832, vol. i. p. 249.

[11] Brewster's "Optics," p. 309.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Saturday, March 16, 1861.

A Course of Ten Lectures on Inorganic Chemistry, by Dr. Edward Frankland, *F.R.S., Lecturer on Chemistry at St. Bartholomew's Hospital.*

Lecture IX.

Having considered in our previous Lectures the principal properties of the elements oxygen, hydrogen, nitrogen, and carbon, and of their chief compounds, we are now in a position to make ourselves acquainted with the atmosphere surrounding our globe, and I intend to devote the present Lecture to some statements with regard to this, to us very important, mass of gaseous matter. The atmosphere consists of a mixture of gaseous, vaporous, liquid, and even solid matters. But the two latter may be regarded as abnormal, and, consequently, we may confine ourselves to the gaseous constituents of this envelope of our globe. Just as the ocean may be presumed to contain a little of everything that is soluble, so we may with equal propriety assume that the atmosphere contains a little of everything that is volatile; but the quantities of most of these substances are so infinitesimally small, that they entirely elude all our attempts even to detect them; nevertheless, even such very unaërial matters as potash, lime, magnesia, iron, and manganese, have been found in the air in very minute quantities under particular circumstances. Since the experiments of Faraday, which have proved that there is a limit of temperature, below which the less volatile substances do not form vapour, we cannot now assume that these solid bodies to which I have just referred are present in the air in the form of gases or vapours; they must be present there in a solid form, and that such solid bodies really do exist in the atmosphere, and are a long time suspended in the air, there can be no doubt. Every sun-beam that passes through a room shows us an infinite number of these very particles hovering in the air. You know if a sun-beam should pass through an opening in a shutter at one end of a room and out of another opening at another side of the room it ought not to illuminate the apartment at all; but the fact is, that it does illuminate it, and that you see the path of the beam through it. Every time a beam of electric light passes through this theatre you see the track of the light—the direction in which it goes,—by means of these little particles reflecting the light and rendering themselves in this way visible. I think it will not be impossible for me to render visible to you the presence of solid particles in the air—particles of matter which cannot really be volatile, which only exist there, in fact, in a state of mechanical suspension,—by means of this nearly colourless gas flame. If you notice it attentively, you will see that there are little yellow particles in it. These yellow particles are due to the presence of common salt in the atmosphere, the little particles of which entering the flame, are there ignited, and communicate the intense yellow colour which each particle is seen to produce when it passes through the flame. Here we have some chloride of sodium. I will simply rub it in this mortar, and then agitate it a little, in order to throw the particles into the air. I dare say the effect will not take place immediately, but if you watch the flame for some little time after I have agitated this chloride of sodium, you will see that those little yellow particles already floating in the room before we commenced the experiment will be greatly increased in number. There are some of them distinctly visible, although the flame is at a great height above the mortar. This proves that these little particles of chloride of sodium, although so many hundred times heavier than the air, still continue to float in the atmosphere, by virtue of their very minute

division, and consequently we can have even permanently solid matters present in the air, just as such matters as gold, for instance, can be suspended for months, or even for years, in water, without sinking to the bottom. If the gold be finely enough divided, it requires months, sometimes it requires even years, to subside through the space of two or three inches of water.

Our atmosphere, as you are aware, extends to a height of some forty-five miles from the surface of the earth, but such is the varying density of the air that when you have risen to the height of three miles in the atmosphere, you have then about one-half of the total weight of the air below you. At that height you might draw a line through the atmosphere which would contain one-half of the atmosphere below it, and one-half above it. Although we generally regard the air as an exceedingly light material, still its absolute weight is far from inconsiderable. I might show you that even a small flask of it contains enough to be very appreciable to a balance of moderate delicacy. It is 815 times lighter than water, and more than 11,000 times lighter than mercury, still, if you conceive a column of atmospheric air extending from this table upwards to the extreme limits of the atmosphere, and measuring only an inch square, that column of air weighs fifteen pounds. A moderate sized room contains sufficient air to crush a man to death if it could be collected together and placed upon him, and this theatre contains considerably more than one ton of atmospheric air. Therefore, you see, although we almost forget its presence around us, still this gaseous envelope of our globe possesses a very considerable absolute weight.

The composition of the atmosphere has for many years engaged the attention of chemists. The first experiments that were made upon the composition of air after it had been ascertained that it consisted chiefly of two gases, namely, nitrogen and oxygen, led to the inference that its components were liable to very considerable variations. It was found that sometimes there was 18 per cent. of oxygen, at other times 19 per cent., at other times 20, and at another time 24 or 25 per cent. of oxygen; and it was imagined that the salubrity or otherwise of any district depended upon the amount of oxygen contained in the air of that district. But these apparent differences in the composition of the atmosphere were due entirely to the defects of the modes of experiment at that time. The modes of estimating the quantity of nitrogen in the air were so defective as to give rise to errors as serious as those to which I have alluded. When this process of analysis became further perfected, the opposite error was fallen into for a short time, and the indications of this more perfect method showed a complete uniformity in the composition of atmospheric air. Specimens of air taken from crowded cities, from the country, and from great heights, were all perfectly uniform in composition. As the methods of analysis, however, still further improved, the incorrectness of this conclusion was also discovered, and it was found that there are variations in the composition of the atmosphere—variations, it is true, within very small limits, indeed, but still far within the reach of experiment to detect. The extent of these variations, and the composition of the air itself taken from different localities, you will see on one of the diagrams before you. Before referring to that, however, perhaps it will be better that I should direct your attention to this table, containing the normal constituents of air in 100 volumes:—

100 *volumes contain*	
Oxygen	20·61 volumes
Nitrogen	77·95 ,,
Carbonic acid	·04 ,,
Aqueous vapour	1·40 ,,
Nitric acid, ammonia, and fire-damp	Traces
	100·00

The first four are the only substances in the air which are capable of exact estimation. Attempts have been made to estimate the ammonia, and probably we have come within a very small fraction of the truth; but we may represent the remaining constituents—nitric acid, ammonia, and fire-damp—by the term "traces," which a chemist usually applies to a quantity of matter so small as to be practically incapable of accurate determination by experiment; the quantities of these materials are so infinitesimally small that they bear scarcely any appreciable relation to the other constituents. Now, you will see that, of these four principal constituents two of them, namely, nitrogen and oxygen, constitute nearly the entire bulk of the air; and if you extract from the atmosphere the aqueous vapour and the carbonic acid, then you have left the oxygen and nitrogen in the proportions indicated in this second table, which contains the results of an extensive series of analyses. It shows you the per-centages of oxygen and nitrogen contained in air that has had its carbonic acid and water (or aqueous vapour) removed from it. There are the results of two analyses of air in nearly every case. Here are two analyses of atmospheric air at St. Bartholomew's Hospital; the two lines of figures represent the two different examinations, and show that the errors of analysis fall within a very small variation. You will see also, from an inspection of the table, that there really is a variation in the composition of air when taken from different localities.

Composition of Atmospheric Air from various Localities.

	Oxygen.	Nitrogen.
St. Bartholomew's Hospital	20·885	79·115
	20·999	79.001
Paris	20·913	79·087
	20·999	79·082
Lyons	20·918	79·082
	20·966	79·034
Toulon	20·912	79·088
	20·982	79·018
Berlin	20·908	79·012
	20·998	79·002
Madrid	20·916	79·084
	20·982	79·018
Geneva	20·909	79·091
	20·993	79·007
Montanvert	20·963	79·037
Summit of Pichincha, 16,000 feet	20·949	79·051
	20·988	79·012
North American Prairie	20·910	79·090
South America	20·960	79·040
Liverpool to Vera Cruz	20·918	79·082
	20·965	79·035
18,000 feet above London	20·880	79·120
Manchester	20·876	79·124
	20·888	79·112
Algiers (June 5, 1851)	20·420	79·580
	20·395	79·605
Bay of Bengal (February 1, 1849)	20·460	79·540
	20·450	79·550
Ganges (March 8, 1849)	20·387	79·613
	20·390	79·610
Southern Asia	20·910	79·090
	20·928	79·072
Polar Sea	20·850	79·150
	20·940	79·060
Grands Mulets (1859)	20·815	79·185
	20·787	79·213
Summit of Mont Blanc (1859)	20·962	79·038
	20·963	79·037
Chamounix (1859)	20·905	79·095
	20·883	77·117

Some of these specimens were taken during a voyage from Liverpool to Vera Cruz; and another in a balloon at a height 18,000 feet above London. The specimen taken at Algiers in 1851, may be regarded as furnishing, what we may term, the first abnormal result; it contains, you see, a comparatively small proportion of oxygen. Our averages have been something like 20·9 of oxygen, but this at Algiers contained only 20·420, or, as determined by the second experiment, only 20·395 of oxygen. You see the two experiments agree very nearly, so that there can be no doubt whatever of the correctness of the two analyses. The analysis of the air of the Ganges was taken at the time when a very violent attack of cholera was breaking out. All the other examples give us almost precisely the same average; and there can be but little doubt that air collected at Algiers and in the Bay of Bengal and on the Ganges would, if examined carefully at the present time, be found to possess also the same composition as the other specimens; but the presence of organic matter in these specimens prevented an accurate determination of the oxygen; in fact, it was noted in the case of the air upon the Ganges, that there were organic emanations proceeding from the river; there was a dense vapour over the river and a very perceptible odour of organic matter in the air. Now, what would be the effect of this organic matter? The effect would be this—that in the analysis of the air, the organic matter would diminish the quantity of oxygen as determined by means of combustion with hydrogen which is the best, and in fact the only correct mode of determining the quantity of oxygen contained in the air. The presence of organic matter would have the effect of reducing the apparent amount of oxygen, and thus the abnormal result would be obtained with the same kind of analysis which was performed upon the other samples. They were all analysed by substantially the same process; but in the case of the air containing these abnormal quantities of organic matter, the amount of oxygen indicated by experiment would be smaller than that actually contained in the air at the time; and there is very little doubt in my own mind that the abnormal results of the examination of these three samples of air are due to this cause—the presence of organic matter.

The mode of estimating the oxygen in atmospheric air is very simple,—at least one ofthe modes of doing it; and I think I shall be able, in the course of a single minute, or little more, to make the experiment before you.

Here is a tube graduated into 100 divisions with decimals. These divisions are not, of course, large enough to be seen at a distance; but I have no doubt we shall see the proportion of the oxygen due to its absorption by the re-agent we shall use to remove it. In all these gaseous analyses it is necessary that the gas, both before and after the application of the re-agent, and before each determination of gaseous volume, should be brought to one uniform temperature and pressure; and this we do in the present instance, as nearly as possible, by immersing the whole apparatus in this vessel of water, which maintains during the whole course of the experiment almost a uniform temperature. Now I think we have got the right quantity of air. The water contained in the lower limb of this endiometer prevents communication between the internal air or gas contained in the tube and the external atmosphere. In reading the volume I bring the two liquids —that is the water outside and that inside the tube—to the same level. Now we have almost exactly 100 volumes of air in this tube. From this liquid in the open limb of the tube I remove a certain quantity by depressing this glass tube open at both ends, and taking out each time a little of the water; and now I am going to pour into it a quantity of caustic potash, which will, of course, have the effect of removing the carbonic acid contained in the air; and we might also, if we could afford the time, determine the amount of carbonic acid contained in this sample of air, by the agitation of the air with this caustic potash; but the absorption would be so trifling, that it is almost impossible to get the result by an experiment of this kind. It is only the oxygen that can be estimated in this way; the carbonic acid, as you have seen from the table, is so minute in quantity, that we may in fact, in this experiment, disregard it altogether, and assume that the air we are operating upon is free from carbonic acid. I am now going to put into the tube some pyrogallate of potash and pyrogallic acid, which has the property of absorbing oxygen with very great rapidity. I have mixed these two solutions, and I will agitate them with a quantity of the air in this tube. You will notice that this solution of pyrogallate of potash, which was first colourless, has become of an intensely red colour, and in the course of a few minutes it will, I dare say, become so dark that it will appear to you almost black. This colour is due to the product of oxidation of the pyrogallic acid, which oxidation takes place at the expense of the oxygen of the air contained in the tube. In this way, by a few minutes' agitation, the whole of the oxygen is removed, and at the same time of course the carbonic acid is removed too; but the latter being in such small quantity we may, as I have said, neglect it altogether. Now, when we allow the liquid to subside you will see, I think, that its level is now here [pointing]; and now I am going to remove my thumb from the open extremity of the tube beneath the surface of some water here, and you will then observe that there will at once be a rise of the liquid in the tube. [The extremity of the tube was accordingly inserted in the water as described.] You see it has now risen to about this point [pointing out the level of water on the scale of the endiometer]. We have, in fact, absorbed the oxygen; and now if we restore our temperature to its original normal condition by immersing the apparatus in this vessel of water, we shall be able to read the volume of gas, which will be, of course, the original volume of air we took *minus* the quantity of oxygen which has been absorbed by that pyrogallate of potash. The temperature is now adjusted by immersion in the water, and the tube brought to the same position as at the commencement of the operation. We have now about 20·4; the liquid has risen between 20·4 and 20·5 in this tube. Now, this, for a rough experiment, is sufficiently near perhaps for our purpose. It ought to have risen 20·9 volumes. If we had time to regulate the temperature and the pressure, and to make our observations with the leisure with which one can make them in a laboratory, we should have obtained by this means very nearly the result of exploding atmospheric air with an excess of hydrogen—20·8 or 20·9 per cent. of oxygen.

Now, we have thus demonstrated the presence of oxygen; and the presence of nitrogen we have demonstrated in a previous Lecture, for you will recollect we prepared our nitrogen in one experiment by burning away the oxygen of the air, when we found that the residue was nitrogen. The presence of aqueous vapour, or moisture, in the air is also very easy of demonstration. Here, for instance, we have had a freezing mixture suspended in this room for some length of time, and it has cooled the outside of this vessel considerably below the freezing point; and you see the moisture contained in the air of this room has crystallized as ice, or hoar frost, upon the outside of this cone of tin. If we allow the vessel to stand until the close of the Lecture, I dare say we shall have some few drops of water, collected from the air, dropping from the end of the cone; in fact, we have on the cone already a few drops of water from the condensation of the aqueous vapour of the atmosphere. Most of it is congealed, and is in a solid form. It will require some little time yet for the temperature of the vessel to rise sufficiently high to melt ice. There is, however, another mode here by which we can illustrate the presence of moisture in the air. We will rarefy a quantity of air which contains moisture, or is nearly saturated with moisture. The temperature of the air under all circum-

stances where it is rarefied, by being pumped out of a receiver in this way, will fall; and air cannot contain so much moisture at a low as at a high temperature. Therefore, if we rarefy the air in the receiver, that air being saturated with moisture will deposit a quantity of moisture in the receiver, on account of the cold produced by the rarefaction; and you will see a cloud within the receiver. This cloud is due to the moisture deposited in the form of very minute drops within the receiver. [The air-pump was worked, and a cloud of moisture was seen within the glass receiver.] You see the glass is now comparatively dim; and there is a kind of cloud or vapour within the receiver. This moisture present in the air is estimated by various instruments which are termed hygrometers. Here is one of them which is that most generally used—Daniell's hygrometer, which consists of two bulbs connected by a glass tube. They contain ether; and as we pour ether upon the outside of one of these bulbs it reduces the temperature even of the other bulb, and the moisture of the atmosphere is deposited upon the black bulb just as it was deposited here upon this tin cone. The operation is watched until that moisture is just beginning to deposit upon the black bulb, and then the temperature of the thermometer in the interior of the bulb is noticed, and we know that the moment when that moisture is deposited upon the bulb, the air at that particular temperature is just saturated with moisture; we further know what amount of moisture is necessary to saturate the air at a particular temperature, as we have already made experiments on this subject. We are thus able to tell from the indications of this instrument the quantity of moisture contained in the air at the time the experiment is made. This table, representing the possible amount of aqueous vapour contained in 100 volumes of atmospheric air at various temperatures, gives us at once that result in per-centage quantities as determined by this instrument.

Temperature F.	Per-centage of Aqueous Vapour	Temperature F.	Per-centage of Aqueous Vapour
0	0·1	47	1·1
10	0·2	50	1·2
20	0·3	52	1·3
25	0·4	54	1·4
29	0·5	56	1·5
32	0·6	58	1·6
35	0·7	59	1·7
38	0·8	60	1·8
41	0·9	70	2·4
44	1·0	80	3·5

If we found, for instance, that we required to reduce the temperature to the zero of Fahrenheit's scale in order to get moisture deposited, we should know then that we had $\frac{1}{10}$th of a volume present in 100 volumes. If we reduce the temperature to 10° before the moisture was deposited, we should know that we had $\frac{2}{10}$ths of a volume present in 100 volumes of air. Thus air at these particular temperatures may contain any amount of aqueous vapour below that in the table, but it cannot possibly contain any amount above the quantity stated there. When the temperature falls below these points, then the vapour is deposited and becomes visible in the form of dew, or rain, or some precipitation of that kind.

The presence of carbonic acid in the air is very readily demonstrated by exposing lime-water, our delicate test for this gas, freely to the atmosphere. Here is a vessel containing lime-water which has been exposed for some hours, and you see it is covered with a film of considerable thickness of carbonate of lime, due to the absorption of carbonic acid from the air.

(To be continued.)

NOTICES OF BOOKS.

A Practical Treatise on Coal, Petroleum, and other Distilled Oils. By Abraham Gesner, M.D., F.G.S., Consulting Chemist, Author of "Industrial Resources," "History of New Brunswick," "Geological Reports," &c., &c. New York: Baillière Brothers, 440, Broadway.

It is now some time since we noticed a kindred work by Dr. Antisell—kindred not only in subject but in treatment. Certainly Dr. Gesner's book has the advantage of being correct so long as its author speaks of what he knows. Dr. Gesner is doubtless a good practical coal distiller, but, scientifically speaking, a poor chemist. We doubt not that he has stood by and directed many hundreds of distillations, and that he has prepared thousands of gallons of his favourite kerosene. Why, then, does he not write solely on practical subjects? and why does he injure his reputation, and bring ridicule upon his book, by an affectation of knowledge upon points where his information is most limited. Dr. Gesner, it is true, surpasses Antisell in his practical knowledge, but, unhappily, he also surpasses him in his blunders. In fact, it would be difficult for any good student of a chemical class to accumulate so many in so short a space. Dr. Gesner's great source of scientific information is the late lamented Dr. Gregory's excellent "Handbook of Organic Chemistry." He has not even obtained the last edition, but has rested satisfied with that of 1852. But, in order to give a fair outline of his book, we will discuss some of his chapters *seriatim*.

Chapter I. is chiefly occupied with a sketch of the history of coal distilling. It is exceedingly brief, but perhaps sufficient, and what is there is written with candour. The descriptions of the varieties of coal, and the results of their analysis, are also extremely brief. The first glaring blunder which attracted our notice is on page 14. The Author, describing the metamorphosis undergone by plants during their conversion into coal, says:—"The changes that have taken place in the original plants during their passage from woody fibre into coal are ascribed to the evolution of a part of their carbon, hydrogen, and oxygen, as there is less of those elements in the coal than in wood." The Author, instead of writing "those elements," should have said less *hydrogen and oxygen*, because coal, as everyone knows, contains far more carbon than wood. A ridiculous passage also occurs on page 16, whether originally due to the printer or Author we cannot tell. Certainly, however, the Author is responsible for permitting such mistakes to pass in the press proofs. Alluding to the pyrogenous derivatives of organic acids, he says:—"Organic acids distilled with strong bases part with the elements of carbonic acid, which uniting with the base and the acid, minus the carbonic acid, comes over in the form of a new product." The passage is in every way inadequate to tell the true story of the formation of ketones, &c. An approach to sense might, however, have been made by writing and punctuating the passage thus:—"Organic acids distilled with strong bases, part with the elements of carbonic acid, which unites with the base; and the acid, minus the carbonic acid, comes over in the form of a new product."

Chapter II. (on the materials employed for the production of oils) is valuable to the coal and tar distiller, and contains much practical information. It is interesting from its allusions to the oil wells which are now attracting so much attention in America.

Chapter III. is on the nature of the products obtained from bituminous substances, and on the apparatus used in distilling. Several stills and ovens are described with their condensers, &c., and the descriptions are practical and tolerably well up to the present state of coal and tar distilling.

Chapter IV. is devoted to the products of the distillation

of wood, coals, asphaltum, bitumen, petroleum, and other substances capable of yielding oils. The Author, like so many of his brother writers on chemistry in America, cannot spell. Capnomor with him is copnomor; pittacal is pittical; aniline is analine; ampeline is ampaline; rosolic is rosalic; carbazotic is carbozotic; St. Evre is St. Evrre; margaric is margonic; bassic acid is made into the paradox basic acid. (See pages 36, 58, 59, 60, 62, 64, 68, 69, 75, 79, 80, &c.) The proof that the errors alluded to are not misprints, is found in the fact of their continual repetition. The Author, in his wretched description of eupion, states that "With nitric acid it forms several new combinations analogous to those of benzole," and that it "Does not exist ready formed in the tars, but is produced by the action of strong acids and alkalies upon the distillates of crude oils." Both these statements are hopelessly incorrect. The little that the Author writes about eupion that is his own, is incorrect, and what he borrows from Dr. Gregory, which includes the chief portion, is taken from an old edition of his work published before the true nature of eupion was made out.

The Author is, we need scarcely say, entirely unacquainted with the modern researches on the nature of the eupion, &c., from Boghead coal.

The Author is fond of dragging in quotations from Dr. Gregory about homologous series, and yet that he is entirely ignorant of their true value in science, is evident from the fact that his lists of homologous bases and hodrocarbons are never correctly written. In a list of "The oily substances obtained by the distillation of coal-tar," cumole is put before toluole; and, among other errors in the list of bases, parvoline is put before lutidine, and the formula of the latter is written C_9H_9N, instead of $C^{14}H^9N$; moreover, pyridine, the first and principal base of the series, is altogether omitted. The same remark applies to lepidine and cryptidine. The Author's judgment is scarcely shown by leaving his tables in the state indicated, and instantly rushing, in the most uncalled-for manner, into an enumeration of the chlorinated and brominated substitution derivatives of naphthaline and aniline, which, with great presumption, considering his evident extreme ignorance of the subject he calls "uncertain combinations."—P. 63.

At page 64 carbozotic acid (*sic*) is one moment called Welter's bitter, and the next, the discovery of it is attributed to M. Guinon, of Lyons, and its formula is given $C_{12}H_3N.O_4O_2$! Would it be believed that after these painful displays of ignorance the Author devotes his next Chapter (V.) to an account of homologous series, with a sketch, copied from Regnault, of the so-called law of atomic weights, being multiples of that of hydrogen; immediately after which, he drags in Dr. Gregory's excellent sketch of the theory of types, but as he commences with the words, "A series of types has therefore been discovered," becomes absolute nonsense, following as it does the quotation from Regnault. It would be of no use to pursue the subject further. Dr. Gesner is probably a very good tar distiller, and may make excellent kerosene (or whatever he chooses to call the fluid known in this country as photogene or paraffine oil); but he is so deficient in his organic chemistry that the best advice we can give him is, to purchase the last edition of his favourite work, and read it carefully before attempting to teach others. It is only fair to mention that the descriptions of the methods of preparing photogene are tolerably clear and practical.

NOTICES OF PATENTS.

Obtaining Pulp for the Manufacture of Paper from Indian Corn. H. Doffegnies, Brussels. (Not proceeded with.)

For the production of a pulp suitable for paper-making, the inventor subjects the waste portions of maize, or Indian corn to certain mechanical processes for the purpose of disintegrating the cellular tissue, and to an after chemical treatment, whereby the plant is divested of small quantities of colouring and extractive matters. The vegetable cellulose prepared in this manner is made to furnish a material like pulp, ready for conversion into paper by the ordinary processes of manufacture. The specification directs that the maize stalks and heads, and in the case of damaged corn, the grain also, be chopped into small pieces in a chaff-cutting machine, then threshed, to remove the sand and earthy impurities. The matters thus purified are washed and pulped in any suitable apparatus, first with water alone and then with soda, again washed with water, and, finally, bleached by the action of chlorine. The white pulp ultimately produced is said to furnish excellent paper.

The failure of this British patent may very possibly be attributable to the want of raw material. In the South of Europe, where maize is more abundantly cultivated, the process would, doubtless, be capable of great results. The modes of treatment, both chemical and mechanical, appear well adapted to the production of a serviceable pulp from maize if only the supply could be obtained.

Manufacture of Colouring Matters and Pigments from Coal-oil, Raw Naphthaline, and from the Waste Lime from Gas-works. L. C. E. Vial, Paris. (Not proceeded with.)

This invention relates to the production of a red colouring matter from crude naphthaline or coal-tar oil, under the combined influence of an alkaline base and of atmospheric oxygen. To purify it from certain associated matters, the coloured principle is dissolved out by treatment with carbonate of soda, and re-precipitated from this solution by acetic or a cheaper mineral acid. The specification describes also a process for obtaining a green or bluish colour from the lime waste which has been employed for the purification of gas. It consists merely in a simple treatment with nitric acid, when the material is precipitated as a deep green or bluish colour, which requires only to be washed to render it fit for use.

Apart from the consideration of expense incident to all processes wherein large amounts of nitric acid would have to be employed, a manufacture based upon the action of acid on products so innately offensive as the "blue Billy" of the gas-works would require to be conducted in remote localities; and, even this point overcome, there will be, according to the showing of the specification, uncertainty in regard to the tint of colour ultimately produced.

CORRESPONDENCE.

Dyeing Magenta.

To the Editor of the Chemical News.

Sir,—Perhaps you will do me the favour to insert the following reply to "Magenta," *alias* "Mares-nest," and as I do not intend to trouble you again on this subject, I hope this will at once remove unfavourable impressions from the minds of gentlemen who manufacture articles which fail to meet with that general approval from practical men which was anticipated, and hope such gentlemen will in future search into the practical objections before publishing to the world assertions that dyers object to use an article simply because it is given to them in a powder.

It is a well-known fact that dyers have suffered, both in pocket and character, by repeated attempts to use the powder, and such other solutions as could be obtained, and after obtaining results with them quite unsatisfactory, they have been compelled to keep goods weeks, instead of days, at no small inconvenience, till they could obtain

some of the well-known makes of solutions, which at one time commanded almost fabulous prices.

I will now lay before you the method most approved by practical men to produce a magenta on Cobourgs, Orleans, &c. After the goods have been properly scoured to remove all foreign matter, the hot-bath is prepared by adding sufficient colouring to produce the colour required, the quantity of hot water being regulated by the amount of cloth to be dyed. The goods are then worked in the bath at about 180 F., till the colour has got even upon the cloth. The cloth is then taken out and washed in cold water, when it will be found that the worsted only has received the dye, the cotton still remaining white, or having but a very slight tint upon it. The cotton is then prepared to receive the colour, by working the goods in a cold solution of galls or sumac, the former being preferable, after which they are worked in a cold dilute solution of neutral chloride of tin. When sumac is used those processes give a buff tint to the cotton, which is objectionable, and can be removed by working the goods in a cold solution of oxalic acid, which will not deteriorate the mordant. The goods are well washed in cold water after the chloride of tin, and also after the oxalic acid. When that article is used the cotton has now received a mordant which enables it to take up the colour, either hot or cold, but experience has proved that the colour is brighter when the cotton is dyed cold; and, consequently, it must be dyed last. The only thing requisite is to add colouring sufficient to a proper quantity of cold water, and work the goods in it till the colour is even upon the cloth, after which they are washed in cold water, then dyed, and finished.

The objections to the colour supplied in powder in the above processes are, that in dyeing worsted a duller colour is produced, and there is an additional objection, which presents itself in the cold process, which bath is not emptied for weeks together, and when the colour is dissolved from the powder by boiling water, and the solution added to the cold bath, it immediately begins to precipitate, from the fact of there being no solvent present to hold the colour in solution. (As I stated before, hot water will hold the colour in solution, but when the aqueous solution becomes cold, it will precipitate.) The sides of the vessel receive a coating of the precipitate, and then the goods come in contact with it, when, in addition to being a bad or inferior colour, they are all stained with the precipitate. There are other objections, but the above will show that dyers are more willing to give things a fair trial, than some manufacturers are to admit their errors.—I am, &c. James Sharp.

Leeds.

MISCELLANEOUS.

Emery.—The trade in emery is not, as formerly, monopolised by the Greek Government, which now levies a tax of 5 drachms per hundred weight when exported. Other hard minerals are sometimes fraudulently substituted for it, to detect which, and to determine the value of the emery, the following method is employed in Smyrna:—A plate of glass of known weight is rubbed with a certain quantity of the emery until it has no further effect; the lighter the glass has become, the better is the quality of the emery. The emery diggings of the Government are on the island of Naxos. A ferruginous clay silicate has lately been discovered upon the island of Skyno, which is not inferior in hardness to emery.—*Wittst. V. Schr.* ix. 535.

Commercial Products of the Asphodel.—Every one is familiar with the pretty, lovely-looking, white-flowered asphodel of our gardens. In the South of Europe, and apparently on both sides of the basin of the Mediterranean, the plant (*Asphodelus ramosus*) is extremely abundant; though it has never, so far as I know, been turned to any account, except that in times of scarcity its acrid fasciculated roots, after much boiling, have been eaten by the poor. In the Paris Exhibition of 1855 there were shown bottles of alcohol extracted from the asphodel; specimens of the resdium of the roots after being twice distilled; paper stuff from the stalks and leaves of asphodel—card-paper, cards, paper and writing-papers, of various qualities, manufactured from the same, and mixed in various proportions with rags and common paper stuff. M. de la Bertoche in a pamphlet, asserts that asphodel roots contain upwards of 27 per cent. of alcoholic principle, or more than double the quantity which resides in the root of beet. The stalks and leaves contain a remarkably tenacious fibre, fine, strong, and flexible. The distillation of asphodel root has been already pursued, and with considerable success, in Algeria; but the immense abundance of the plant in Tuscany, where it has hitherto been considered only a pernicious and most ineradicable weed, points to the advantage of endeavouring to turn it to account. The fasciculated roots, after cleansing and crushing, are mixed with water, and the fluid is exposed to heat, so as to facilitate fermentation. The alcohol which it yields is pure and colourless, perfectly transparent, and has the colour of alcohol itself. It contains neither acid salt, nor oily matter; it burns without leaving any residue, and the flame is remarkably bright. But at the present time, when material for paper seems likely to fail, a most important succedaneum is afforded by the remains of asphodel. It is undeniable that the residuum of the roots after distillation, together with the other parts of the plant, are eminently adapted to this object. Three processes are necessary; the separation of the useful portions,—the bleaching,—and the reducing the substances into a homogeneous and tenacious pulp. The first is better effected by crushing than by grinding, as the latter mode is apt to destroy the fibre. The second operation involves most difficulty, as the root is covered with a skin which contains a tanning principle; and it is necessary, unless the expensive mode of hand-picking the root be adopted, to expose the substance to air and light, aided by immersion in diluted chlorine, which brings the substance to a very pale brown tint, which is not objectionable for many sorts of paper. For the third process, that of reducing the whole mass to a smooth and tenacious paste, the paper manufacturers must supply the details.—*Sir W. J. Hooker, K.H., F.R.S., in the Technologist.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

Permanent Marking Ink.—Indian ink, or the finest lamp-black, with a solution of shellac in borax gives an ink which is not affected by chlorine or cyanide of potassium, or by acids. No nitrate of silver is necessary.

Varnish for Iron.—The best varnish for iron chains is made of pure linseed oil well boiled and rendered quick drying by adding some litharge—about four ounces to the gallon. Colour it black by adding some lamp-black and a little asphalt. When resin is added to oil it renders it more liable to scale off. The chains should be thoroughly dried in a hot room before they are used.

Pigmy.—The subject is one which has occupied the attention of scientific men for some years. It has, however, never yet been really accomplished.

F. R. G.—In September next.

A Victim.—Your case is hard, but you would gain nothing by taking proceedings. What is the use of winning an action against a pauper? He could not pay any expenses.

THE CHEMICAL NEWS.

VOL. IV. No. 87.—August 3, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Estimation of Commercial Saltpetres, by M. J. PERSOZ.

THE best method for estimating the water is to melt carefully from 50 to 200 grammes of nitre in a platinum capsule, taking care that the temperature is not raised much above the fusing point. Weigh the crucible immediately after cooling. If the saltpetre contains nitrate of lime or magnesia add about 1 gramme of well-dried neutral chromate of potash, which prevents loss of nitric acid from these nitrates, so easily decomposed by heat.

To estimate insoluble matters, treat the melted mass with water so as to form a determinate volume of solution N. Filter this carefully; collect, wash, and weigh the insoluble precipitate.

Gay-Lussac's method employed for the estimation of chlorides is to use two standard solutions, one containing 27 grammes and the other 2·7 grammes of pure silver to the litre. Each cubic centimètre of the stronger solution corresponds to 0·01466 grammes of chloride of sodium or 0·01864 grammes of chloride of potassium.

To estimate sulphates, a standard solution of chloride of barium is used, containing 259·8 grammes of salt, each cubic centimètre representing 0·179 grammes of sulphate of soda, or 0·208 grammes of sulphate of potassa. The operation is conducted in the following manner:—Measure 200 cubic centimètres of the solution N of nitre; after adding a few drops of acid, introduce it into a platinum capsule and boil it freely; then carefully pour in a slight excess of standard solution. At this point of the process fill a graduated burette with the solution N, and add it, little by little, until the excess of barytic standard solution is exactly precipitated. This last operation is somewhat tedious and difficult, because the solutions do not readily become clear, and it is often necessary to filter small trial quantities. The relation between the total volume of N employed and the volume of barytic standard solution gives the proportion of sulphate in a given weight of nitre.

Nitric acid is estimated in a very elegant manner, by using dry bichromate of potash, which expels nitric acid from the alkaline nitrates without decomposing the chlorides. The operation is thus conducted:—On a lump of saltpetre, melted and cooled, weighing from 2 to 5 grammes, and placed in a small but sufficiently large platinum crucible, place about twice its weight of previously melted and pulverised bichromate of potash. Weigh, and then carefully heat the whole. At first the reaction is somewhat energetic, and it frequently happens that considerable quantities of the mixture are carried off and are condensed on the inner surface of the cover, which should be shaped like a deep capsule, so that the fusible matter projected against it may fall in the crucible. In proportion as the nitrous vapours diminish raise the temperature to a dull red heat, taking care to equalise the temperature of the cover by directing a gas jet on it. When the operation is finished leave the crucible uncovered for a few instants, that the air in it may be renewed; allow it to cool, and weigh it. The loss of weight indicates the quantity of nitric acid displaced, from which may be calculated the corresponding proportion of nitrate of potash or soda.

If the nitrate analysed contains at the same time potash and soda an excess will be found by converting the estimated nitric acid into nitrate of potash; and, on the contrary, a deficiency, by converting the acid into nitrate of soda. This excess or deficiency allows of the calculation of the relative proportion of the two alkaline nitrates in the salt analysed.—*Annales du Conservatoire des Arts et Metiers.*

On the Preparation of an Ethereal Solution of Binoxide of Hydrogen.

THIS has been recommended by Dr. H. Storer as a test for chromic acid. Professor R. Böttger proposes the following method for preparing a solution which will keep unaltered for a long time. A piece of sodium, of the size of a hazel-nut, and freed from petroleum, is heated in a rather flat, somewhat inclined porcelain capsule, over a Bunsen gas burner, to fusion, so that it ignites when stirred in contact with the air by means of an iron rod. As soon as the burning and glowing ceases, it is transferred to a well-stoppered vial. Of this impure binoxide of sodium, small particles are carried into about an ounce of very dilute sulphuric acid (1 to 24 water) contained in a narrow cylinder which is kept cool. After the third or fourth introduction, ether is added, the liquids agitated, and after separation the ether removed; this may be continued until the ethereal solution ceases to produce an intensely blue colour with a diluted solution of chromic acid. With little material, a considerable quantity of this new reagent is produced in a short time.—*Wittst. V. Schr.* ix. 546.

On the Employment of Hypochloric Acid as an Oxidiser and Solvent, by M. BRUNNER.

ORES, attacked with considerable difficulty, are easily oxidised by nascent hypochloric acid—for instance, chrome iron, sulphide of molybdenum, uranium ore, &c. M. Brunner recommends mixing the ores, reduced to an impalpable powder, with eight times their weight of chlorate of potash, placing the mixture in a flat-bottomed capsule, and pouring into it sulphuric acid diluted with one-half to once and even twice its volume of quite cold water.

The more easily attacked the ore, the more should the

sulphuric acid be diluted. Acid with half its volume of water may be used for chrome iron. It requires stirring from time to time without the application of heat, and not till the expiration of twenty-four hours can the operation be terminated by the application of a gentle heat. 15 cubic centimètres of sulphuric acid are sufficient for 1 gramme of chrome ore, and it should be added in two portions. Crystals of chromic acid gradually appear in the mixture.

By avoiding raising the temperature, and the use of an acid too concentrated, there need be no fear of explosions, in which there is really no danger, but which may occasion loss of material.—*Repertoire de Chemie.*

TECHNICAL CHEMISTRY.

On Aluminium Bronze, by Barnard S. Proctor.

The chemical relations of aluminium and the mechanical properties of aluminium bronze have had frequent notice, and may be said to have been fairly introduced to the notice of those who are likely to make use of either material in the arts or manufactures; but the question of how far the chemical affinities of the copper are modified by its union with aluminium appears to have had less attention than it deserves.

The following simple experiments comparing the relative powers of aluminium bronze and ordinary brass to withstand the action of various agents were designed to point out how far the new material could offer advantages over brass for the construction of apparatus, philosophical instruments, or domestic utensils:—

Bronze Filings.	Brass Filings.
No. 1. *With Nitric Acid*, 1·42.	
Acted freely, not violently.	Acted violently.
No. 2. *Dilute Nitric Acid, P. L.*	
No evident action while cold, acted freely while boiling, but ceased again on cooling.	A feeble action while cold' a free action while hot reduced again on cooling.
No. 3. *Dilute Hydrochloric Acid, P.L.*	
No evident action, either cold or hot. The acid being boiled for a minute upon the filings and decanted gave no indication with ammonia, but with sulphuret of ammonia, on standing a few hours, there was evident dark precipitate.	In every particular the same as the bronze.
No. 4. *Dilute Nitric and Hydrochloric Acids Mixed.*	
Slowly but completely dissolved.	Dissolved a little more quickly.
No. 5. *Strong Hydrochloric Acid.*	
No evident action while cold, and only feeble on boiling, the colour produced with ammonia being just visible, and with the sulphuret clearly evident.	Similar to the bronze, but the action a little more evident.
No. 6. *Dilute Sulphuric Acid.*	
With a few seconds' boiling, did not give indication with ammonia, but coloured with the sulphuret.	Acted the same as the bronze, but a little more strongly.
No. 7 *Acetic Acid, P. L. Strength.*	
A few filings in the bottom of the tube containing the acid were considerably acted upon in the course of fourteen hours, the liquor being dark green, and many small green crystals upon the sides of the tube, apparently from the action of the vapour upon the filings which had adhered to the glass.	Not evidently more acted upon than the bronze.
No. 8. *Solution of Ammonia, ·960 specific gravity, in the bottom of a tube.*	
The action of air, moisture, and ammonia for twenty-four hours dissolved the few filings which had been placed in the tube, producing a blue liquor and white precipitate.	Similar to the bronze, but without the precipitate.

A piece of bronze cut from the ingot, hammered flat, filed to a smooth surface, and finished with fine emery-paper, and a piece of brass tube treated in the same manner were subjected to the following experiments, being cleaned with emery-paper between each:—

No. 9. The metals were wrapped in paper and placed in a jar of sesquicarbonate of ammonia. After a few hours the brass was black, and the paper stained blue; the bronze did not seem to have been acted upon. After twenty-four hours a slight action was perceptible upon the bronze, there being a few blue specks upon the metal and blue spots upon the wrapper, but the general surface of the metal still clean. After several days, the spots had increased, but the general surface was scarcely acted upon.

No. 10. Wrapped in paper and placed in a jar of sulphuret of potassium, were not tarnished perceptibly in twenty-four hours. On being wetted and returned to the jar, they were both tarnished, but the bronze less than the brass.

No. 11. Sprinkled with carbonate of potass, which was allowed to deliquesce upon their surface, in two hours the brass was evidently tarnished; in twelve hours considerably tarnished. The bronze unaltered after twenty-four hours.

No. 12. Sprinkled with acetate of potass, in two hours brass was evidently acted upon; in twelve hours considerably tarnished, the spots where the salt had deliquesced being almost black. In twenty-four hours the bronze had suffered nothing, its surface being clean and simply moist with the deliquesced salt.

No. 13. Half covered with a weak solution of tartaric acid, both became gradually tarnished, and in forty-eight hours were covered with thin, adhering crusts, white on the bronze, black on the brass. The crusts did not wash off nor rub off, except with hard friction. The water with which the acid had been washed off gave distinct but not copious blue with ammonia.

No. 14. As No. 13, but with citric acid. Both were tarnished, but much less so than in the last. The coating upon the bronze was thin, green, and varnish-like. The washings gave with ammonia much stronger indications than No. 13, showing that the discoloration of the surface is not a fair indication of the quantity of metal dissolved.

No. 15. Sprinkled with cream of tartar and water

and allowed to dry. The tartarate upon both had become greenish, and the surface tarnished, but less upon the bronze than the brass.

No. 16. Treated as No. 15, but with binoxalate of potassa. The action similar but stronger. The bronze again was least acted upon.

No. 17. Exposed to a moist atmosphere containing ammonia. Eight hours: the brass was much blackened, the bronze slightly tarnished; twenty-four hours: the corrosion of the brass had gone on rapidly, its surface being black, rough, and covered with small drops of blue liquid; the bronze was dull, but not much discoloured, and there were few small specks of blue liquid upon its surface.

No. 18. Exposed to the fumes of a solution of hydrosulphuret of ammonia, a drop of the solution also being placed upon the metals. In five minutes the brass was considerably acted upon by the solution, but scarcely at all by the vapour. The bronze was almost instantly tarnished by the vapour, but very little acted upon by the solution. In half-an-hour the brass was tarnished yellow over its general surface, and the edges were black. The action on the bronze did not seem to have increased.

No. 19. Exposed to moist air containing sulphuretted hydrogen. The bronze was almost instantly discoloured, but the brass scarcely visibly so. After remaining a few days under this action the metals appeared acted on to much the same extent, but the brass had an orange coloured tarnish, spotted with black; the bronze a greenish-grey tarnish, likewise spotted with black. (Compare Experiment No. 10.)

No. 20. Exposed to a moist air containing chlorine. Eight hours produced a very slight tarnish upon both. The quantity of chlorine being considerably increased so as to smell pungent, the action became considerable; in the course of a few hours a green crust was formed upon both, which, when scraped off left the brass with a dirty surface, but the bronze almost clean.

No. 21. Exposed to the fumes of nitric acid, specific gravity 1·42, eight hours. Both metals were acted upon and moist, the brass being black, the bronze not much discoloured, but having a loose precipitate which easily wiped off its surface.

No. 22. Exposed to the fumes of hydrochloric acid, specific gravity 1·16, one hour. The brass was growing black at the edges, and its whole surface somewhat dull; the bronze almost equally dull, but not black at the edges. Thirty-six hours: brass covered with a strongly adhering, smooth black crust, upon which was standing a considerable quantity of green solution containing green crystals; the bronze was covered with a pale slate-grey precipitate, moist, and easily rubbed off, leaving the surface perceptibly roughened. Examined with a one-inch lens, it had the appearance of crystalline structure. The brass, after cleaning with ammonia and sulphuric acid, exhibited a surface somewhat less roughened and not crystalline.

No. 23. Exposed to the action of moist air containing sulphurous acid. The change was slow; eight hours rendered the surfaces dull, that of the bronze somewhat copper-coloured. The quantity of sulphurous acid being increased so as to smell pungent, the brass soon acquired a thin but quite perceptible film upon its centre. In fourteen hours the brass was dark green-brown, and coated with crystals; the bronze of a copper-brown, with crystals and solution by deliquescence. Washing with water removed most part of the film from both. Under a one-inch lens the brass was distinctly pitted; the bronze was pitted much more minutely, being scarcely distinguishable with one inch focus.

No. 24. Exposed to the vapour of iodine at 70° F. Both were acted upon about equally quickly. After eight hours the bronze had a grey-white film, which easily rubbed off, leaving the surface little altered; the brass had a grey-black film, part of which rubbed off readily, and left the surface bright but black.

No. 25. Exposed to the action of salt water. Twelve hours produced a little discoloration of the brass, but no visible change upon the bronze. Twenty-four hours: the salt having crystallised upon the metals, the bronze was slightly dull after washing with water; the brass dull grey, tarnished, the metallic lustre being slightly visible through the coating.

No. 26. Exposed to vinegar, which was allowed slowly to evaporate upon them. The brass was much discoloured, and had green crystals on its surface; the bronze very little discoloured, but slightly more crystals upon it. Under the microscope the brass seemed most uniformly acted upon, there being a general roughness over its surface. The bronze in places was corrugated, as if from an indistinct crystalline texture.

No. 27. Exposed to ordinary coal-gas within the gas-fittings, where a slow current passed over them for eight or ten hours per day, the sample remaining in a stationary charge of gas during the remainder of the twenty-four hours. One week produced scarcely any change; two weeks, the general surface of the metals was tarnished, and the brass strongly discoloured at the edges.

No. 28. The metals, after being burnished, were exposed to the air in the shop (Pharmaceutical). Five days: bronze had an orange-yellow tarnish; brass a greenish-grey tarnish about equal in depth.

No. 29. Burnished and exposed to the weather on the roof of the house. Five days: rain, wind, and sunshine repeatedly alternated. Bronze little tarnished, and little spotted; the brass was considerably more tarnished, spotted, had a black discoloration round the edge, and was more difficult to clean.

No. 30. A repetition of No. 28, the surfaces instead of being burnished were cleaned with fine powdered pumice and oxalic acid. Results the same as No. 28.

No. 31. A repetition of No. 29, with cleaned instead of burnished surfaces, gave similar results—if anything, still more strongly in favour of the bronze.

From the above experiments, it appears that the bronze has a little advantage over ordinary brass in its power of withstanding corrosion, and that its surface, when tarnished, is more readily cleansed. This should give it a general preference where cost of material is not an important consideration, especially if strength, lightness, or durability is at the same time desirable. It would be out of my province to say anything with regard to its fitness for delicate machinery, such as clocks and watches, except that its chemical examination has revealed nothing which can detract from the preference which its mechanical superiority should give it.

Being so much less acted upon by ammoniacal salts and coal gas (*see* Experiments 9, 17, 18), it appears to offer advantages for the construction of gas-metres, stop-cocks, and moveable joints in gas-fittings.

Its withstanding the action of some deliquescent salts (*see* Experiments 11, 12), suggests its suitability for chemists' scales and weights, scoops, &c. Its resistence to the action of the weather, and the ease with which the tarnish is removed, renders it specially applicable for door-plates, bell-handles, &c. Its mechanical strength

and chemical inactivity together recommend it for hinges, &c., which are to be exposed to the weather.

In Experiments 18, 22, 27, 29, the tendency of brass to corrosion at its edges, and at any roughness upon its surface, will be observed, and that the bronze is free from this defect.

In several cases (*e.g.* Nos. 18 and 19), the bronze seemed to be most quickly covered with a slight tarnish, which did not increase perceptibly, probably the tarnish acting as a protection to the metal; but the brass, though less rapidly discoloured, continued to be corroded, apparently with increased speed as the action was continued.

In Experiments No. 20, 21, 22, 29, we find the bronze to be much more easily cleaned, a circumstance of considerable importance in its application to many purposes.

For culinary vessels its superiority to the materials now in use appears questionable.

Drawing instruments, pneumatic apparatus, stage fittings for microscopes, telescope tubes, and various other philosophical instruments are among the purposes for which the use of the bronze appears advantageous.

Undoubtedly, the greatest obstacle to its extensive application is its high price, resulting partly, it is said, from the great difficulty of procuring copper in a state of sufficient purity for the production of a good bronze, the presence of a small portion of iron, &c., being very prejudicial. But surely, the talent which has removed aluminium from its position among the rare minerals of the cabinet to an article of commerce, which has already reduced its price from 60*l.* to 60*s.* per lb., will not be long in devising the means of producing both aluminium and pure copper at a still more moderate price.

11, Grey Street, Newcastle-upon-Tyne.

P.S.—With a home-made pen of aluminium-bronze I add a postscript to my article, to suggest that this material is well worthy the attention of steel-pen makers. From two days' work with this badly-constructed pen, I anticipate that the material will, when well worked, be found to possess both chemical and mechanical properties to recommend it for this purpose.

On the Best Form for Chimneys, by L. C. LEVOIR,[1] *Phil. Nat. Doct., Leyden University.*

IT is a long discussed question, whether chimneys should be made conical with the largest base beneath, cylindrical, or conical with the largest opening at the outlet in the air. Some time ago I tried an experiment which apparently showed that the last form was the best one.

When two adjacent gas-flames are caused to burn from the same tube, the outlets being equal, and about a quarter of an inch wide, and the pressure very low, the flames have the same length when placed in the same horizontal level. But as soon as one is placed higher than the other that one becomes taller by the diminution of pressure higher in the atmosphere.

By putting a conical tube of about three feet in length on one of the flames, when they are burning equal, the greatest suction results when the conical tube is placed with the largest end upwards. The greater suction is not resulting from the higher temperature which the smaller end of the tube assumes, owing to its being placed so much nearer to the flame, for a stream of cold water flowing round the tube does not occasion a greater length of the flame on which the conical tube is not adapted.

This experiment is a confirmation of a fact which several engineers have long since observed. The reason why so many chimneys are still built cylindrical, or conical, with the widest section beneath, seems to me to be that the influence of the winds—especially those occurring in the daytime, which seem to have a less horizontal direction than those at night—interferes more with the flowing out of the products of combustion as the outlet of the chimneys become wider. Suitable covering head-pieces, to turn with the wind, would highly improve the suction in conical chimneys, and also prevent the smoke from blowing down in so inconvenient a manner.

[1] It will give us much pleasure to receive further communications from this Correspondent.—ED. C. N.

PHARMACY, TOXICOLOGY, &c.

On the Use of Phenic Acid for Disinfecting Purposes, and its Mode of Action, by M. J. LEMAIRE.

SINCE MM. Corne and Demeaux's paper on "Coal-tar" was presented to the Academy, M. Dumas has stated that the disinfecting properties of this body are due to phenic acid. M. Lemaire's experiments prove this opinion correct. He has witnessed the efficacy of phenic acid dissolved or made into emulsion in the preservation of animal matters. Phenic acid made into an emulsion and injected into the bodies of animals will preserve them unaltered in contact with the air; a human adult body can be preserved with less than 50 centimes.

The author has already indicated an important application of phenic acid to the destruction of parasites. An aqueous solution of 1 per cent. of this acid, and 40 per cent. of acetic acid removes tinea in 30 or 40 days, and cures itch speedily. Acetic acid is added to the preparation, to enable the medicament to penetrate the epidermis, so as to reach the bulbs of the hair. I am of opinion that the same solution would serve to destroy domestic insects; the powders used for this purpose are effective, but the solution would penetrate better into the crevices of furniture.

On Medicinal Aconitine and its Substitutes, by WILLIAM PROCTER, *jun.*

THE high price and variable quality of aconitine has rendered its use as a medicinal agent so expensive and uncertain, that many physicians never employ it, depending upon the stronger tinctures of the root, in cases requiring the external use of aconite. In the manufacture of organic chemical products very much is added to their cost by the complications and loss rendered necessary or unavoidable in their purification from colouring matter, or strongly adherent resinous or other inert substances in minute quantity, which, while their presence impairs the market value of the chemicals, often do not greatly reduce their medicinal power. In asking the attention of pharmaceutists to the following modification of Headland's process for aconitine, it is with the view of furnishing them with a practicable means of supplying their own wants in regard to this potent alkaloid.

It is proper to premise that aconite root contains a

green fixed oil, solid below 70° Faht., which it is important to remove entirely from the solution, before attempting to extract the alkaloid by the agency of ether, a precaution only partially carried out in the published process of Dr. Headland. When a tincture of aconite root in alcohol of sp. gr. ·835, whether prepared in the cold by percolation or by digestion at the temperature of boiling alcohol, as recommended by Headland, is evaporated to one-half the weight of the root treated, a quantity of the green fatty oil above noticed separates and floats upon the surface of the liquid. Most of this may be strained out, if the temperature is below 70° Faht., but a portion, together with some resin, remains intimately combined in the clear liquid, and it is this which is not removed previously to adding the ammonia, in the process of Headland. Further, aconitic acid is soluble in ether, and aconitate of ammonia may be slightly so, in which case it also would tend to contaminate the aconitine in that process.

Take of aconite root, in fine powder, five pounds; alcohol ·835, ether, and strong solution of ammonia, of each a sufficient quantity. Moisten the aconite root with two pints of alcohol, and let it stand twenty-four hours in a covered vessel, then, having packed it closely in a cylindrical percolator, pour on alcohol until three gallons have slowly passed, or until the root is so far exhausted that the passing liquid has little, if any, taste of aconite. To the tincture thus formed, add an ounce of lime, previously hydrated and in powder, and agitate them together, separate the precipitate which forms, by straining through a close cloth, and saturate the liquid with diluted sulphuric acid till slightly acid. Filter the liquid through a close filter, and distil off the alcohol, until the remaining liquid measures about a pint and a-half. Remove any fixed oil which may separate on standing, and having continued the evaporation to a syrupy consistence, agitate it well with four fluid ounces of ether in a suitable bottle, and decant the ether when it has separated. Then add the solution of ammonia in excess, agitate thoroughly, wash the mixture with repeated portions of ether, by agitation and decantation, and having mixed these last ethereal liquids, allow the ether to evaporate spontaneously from a capsule, until the aconitine remains as a dry, amorphous, shining residue, which should be removed from the capsule, powdered, and preserved for use in a stoppered vial.

As thus obtained, aconitine is a powder of greenish or brownish-white colour, uncrystallised, very soluble in alcohol, ether, and chloroform, saturates acids, and has a strong alkaline reaction. It irritates the nose powerfully when a minute particle is inhaled, but does not excite sneezing.

Modes of Using Aconitine.—When aconitine is to be employed in the form of an ointment, its activity may be much increased by adding to it a sufficiency of acetic acid to salify it, which renders it more readily absorbable in contact with the skin. The powder should first be triturated with a few drops of alcohol, and the acid added to this, in the proportion of a drop of acetic acid to each grain of the alkaloid.

Glycerole.—When aconitine is mixed with a slight excess of acetic acid, it readily dissolves in glycerin, and in this state may be applied by friction to the surface requiring its anæsthetic action. The proportion of the alkaloid to each preparation must be regulated by the prescriber; two or three grains to the drachm of prepared lard is a maximum strength for the ointment, and from this down to one grain.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Weekly Evening Meeting, Friday, June 7, 1861.

The Duke *of* Northumberland, *K.G., F.R.S, President, in the Chair.*

On the Physical Basis of Solar Chemistry, by John Tyndall, *Esq., F.R.S., Professor of Natural Philosophy, Royal Institution.*

Omitting all preface, the speaker drew attention to an experimental arrangement intended to prove that gaseous bodies radiate heat in different degrees. Behind a double screen of polished tin was placed an ordinary ring gas-burner; on this was placed a hot copper ball, from which a column of heated air ascended; behind the screen, but so placed that no ray from the ball could reach the instrument, was an excellent thermo-electric pile, connected by wires with a very delicate galvanometer. The thermo-electric pile was known to be an instrument whereby heat was applied to the generation of electric currents, the strength of the current being an accurate measure of the quantity of the heat. As long as both faces of the pile were at the same temperature no current was produced; but the slightest difference in the temperature of the two faces at once declared itself by the production of a current, which, when carried through the galvanometer, indicated by the deflection of the needle, both its strength and its direction.

The two faces of the pile were in the first instance brought to the same temperature; the equilibrium being shown by the needle of the galvanometer standing at zero. The rays emitted by the current of hot air already referred to were permitted to fall upon one of the faces of the pile; and an extremely slight movement of the needle showed that the radiation from the hot air, though sensible, was extremely feeble. Connected with the ring-burner was a holder containing oxygen gas; and by turning a cock, a stream of this gas was permitted to issue from the burner, strike the copper ball, and ascend in a heated column in front of the pile. The result was, that oxygen showed itself, as a radiator of heat, to be quite as feeble as atmospheric air.

A second holder, containing olefiant gas, was also connected by its own system of tubes with the ring-burner. Oxygen had already flowed over the ball and cooled it in some degree. Hence, as a radiator, in comparison with oxygen, the olefiant gas laboured under a disadvantage. It was purposely arranged that this should be the case; so that if, notwithstanding its being less hot, the olefiant gas showed itself a better radiator, its claim to superiority in this respect would be decisively proved. On permitting the gas to issue upwards, it cast an amount of heat against the adjacent face of the pile sufficient to impel the needle of the galvanometer almost to its stops at 90°. This experiment proved the vast difference between two equally transparent gases with regard to their power of emitting radiant heat.

The converse experiment was now performed. The thermo-electric pile was removed and placed between two cubes filled with water kept in a state of constant ebullition; and it was so arranged that the quantities of heat falling from the cubes on the opposite faces of the pile were exactly equal, thus neutralising each other. The needle of the galvanometer being at zero, a sheet of oxygen gas was caused to issue from a slit between one of the cubes and the adjacent face of the pile. If this sheet of gas possessed any sensible power of intercepting the thermal rays from the cube, one face of the pile being deprived of the heat thus intercepted, a difference of temperature between its two faces would instantly set in, and

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the result would be declared by the galvanometer. The quantity absorbed by the oxygen under those circumstances was too feeble to affect the galvanometer; the gas, in fact, proved sensibly transparent to the rays of heat. It had but a feeble power of radiation; it had an equally feeble power of absorption.

The pile remaining in its position, a sheet of olefiant gas was caused to issue from the same slit as that through which the oxygen had passed. No one present could see the gas. It was quite invisible; the light went through it as freely as through oxygen or air; but its effect upon the thermal rays emanating from the cube was what might be expected from a sheet of metal. A quantity so large was cut off that the needle of the galvanometer, promptly quitting the zero line, moved with energy to its stops: thus, the olefiant gas, so light and clear and pervious to luminous rays, was a most potent destroyer of the rays emanating from an obscure source. The reciprocity of action established in the case of oxygen comes out here; the good radiator is found by this experiment to be the good absorber.

This result, which was exhibited before a public audience this evening for the first time, was typical of what had been obtained with gases generally. Going through the entire list of gases and vapours in this way, we should find radiation and absorption to be as rigidly associated as positive and negative in electricity, or as north and south polarity in magnetism. The gas which, when heated is most competent to generate a calorific ray, is precisely that which is most competent to stop such a ray. If the radiation be high, the absorption is high; if the radiation be moderate, the absorption is moderate; if the radiation be low, the absorption is low; so that if we make the number which expresses the absorptive power the numerator of a fraction, and that which expresses its radiative power the denominator, the result would be, that, on account of the numerator and denominator varying in the same proportion, the value of that fraction would always remain the same, whatever might be the gas or vapour experimented with.

But why should this reciprocity exist? What is the meaning of absorption? What is the meaning of radiation? When you cast a stone into still water, rings of waves surround the place where it falls; motion is radiated on all sides from the centre of disturbance. When the hammer strikes a bell, the latter vibrates; and sound, which is nothing more than an undulatory motion of the air, is radiated in all directions. Modern philosophy reduces light and heat to the same mechanical category. A luminous body is one with its particles in a state of vibration; a hot body is one with its particles also vibrating, but at a rate which is incompetent to excite the sense of vision; and, as a sounding body has the air around it, through which it propagates its vibrations, so also the luminous or heated body has a medium, called ether, which accepts its motions and carries them forward with inconceivable velocity. Radiation, then, as regards both light and heat, is the transference of motion from the vibrating body to the ether in which it swings; and, as in the case of sound, the motion imparted to the air is soon transferred to the surrounding objects, against which the aërial undulations strike, the sound being, in technical language, absorbed; so also with regard to light and heat, absorption consists in the transference of motion from the agitated ether to the particles of the absorbing body.

The simple atoms are found to be bad radiators; the compound atoms good ones; and the higher the degree of complexity in the atomic grouping, the more potent, as a general rule, is the radiation and absorption. Let us get definite ideas here, however gross, and purify them afterwards by the process of abstraction. Imagine our simple atoms swinging like single spheres in the ether; they cannot create the swell which a group of them united to form a system can produce. An oar runs freely edgeways through the water, and imparts far less of its motion to the water than when its broad, flat side is brought to bear upon it. In our present language, the oar, broad side vertical, is a good radiator; broad side horizontal, it is a bad radiator. Conversely, the waves of water, impinging upon the flat face of the oar-blade, will impart a greater amount of motion to it than when impinging upon the edge. In the position in which the oar radiates well it also absorbs well. Simple atoms glide through the ether without much resistance; compound ones encounter this, and yield up more speedily their motion to the ether. Mix oxygen and nitrogen mechanically, they absorb and radiate a certain amount. Cause these gases to combine chemically and form nitrous oxide, both the absorption and radiation are thereby augmented 250 times!

In this way we look with the telescope of the intellect into atomic systems, and obtain a conception of processes which the eye of sense can never reach. But gases and vapours possess a power of choice as to the rays which they absorb. They single out certain groups of rays for destruction, and allow other groups to pass unharmed. This is best illustrated by a famous experiment of Sir David Brewster's, modified to suit the requirements of the present discourse. Into a glass cylinder, with its ends stopped by discs of plate glass, a small quantity of nitrous acid gas was introduced; the presence of the gas being indicated by its rich brown colour. The beam from an electric lamp being sent through two prisms of bisulphide of carbon, a spectrum seven feet long and eighteen inches wide was cast upon a screen. Introducing the cylinder containing the nitrous acid into the path of the beam as it issued from the lamp, the splendid and continuous spectrum became instantly furrowed by numerous dark bands, the rays answering to which were struck down by the nitric gas, while it permitted the light which fell upon the intervening spaces to pass with comparative impunity.

Here, also, the principle of reciprocity, as regards radiation and absorption, holds good; and could we, without otherwise altering its physical character, render that nitrous gas luminous, we should find that the very rays which it absorbs are precisely those which it would emit. When atmospheric air and other gases are brought to a state of intense incandescence by the passage of an electric spark, the spectra which we obtain from them consist of a series of bright bands. But such spectra are produced with the greatest brilliancy, when, instead of ordinary gases, we make use of metals heated so highly as to volatilise them. This is easily done by the voltaic current. A capsule of carbon was filled with mercury, which formed the positive electrode of the electric lamp; a carbon point was brought down upon this; and on separating one from the other, a brilliant arc containing the mercury, in a volatilised condition passed between them. The spectrum of this arc was not continuous, like that from the solid carbon points, but consisted of a series of vivid bands, each corresponding in colour to that particular portion of the spectrum to which its rays belonged. Copper gave its system of bands; zinc gave its system; and brass, which is an alloy of copper and zinc, gave a splendid spectrum made up of the bands belonging to both metals.

Not only, however, when metals are united, like zinc and copper, to form an alloy is it possible to obtain the bands which belonged to them. No matter how we may disguise the metal—allowing it to unite with oxygen to form an oxide, and this again with acid to form a salt; if the heat applied be sufficiently intense, the bands belonging to the metal reveal themselves with perfect definition. Holes were drilled in a cylinder of retort carbon, and these being filled with pure culinary salt, the carbon was made the positive electrode of the lamp: the resultant spectrum showed the brilliant yellow lines of the metal sodium. Similar experiments were made with the chlorides of

strontium, calcium, lithium,[1] and other metals; each salt gave the bands due to the metal. Different salts were then mixed together, and rammed into the holes in the carbon. A spectrum was obtained which contained the bands of them all.

The position of these bright bands never varies, and each metal has its own system. Hence the competent observer can infer from the bands of the spectrum the metals which produce it. It is a language addressed to the eye instead of the ear; and the certainty would not be augmented if each metal possessed the power of audibly calling out, "I am here!" Nor is this language affected by distance. If we find that the sun or the stars give us the bands of our terrestrial metals it is a declaration on the part of these orbs that such metals enter into their composition. Does the sun give us any such intimation? Does the solar spectrum exhibit bright lines which we might compare with those produced by our terrestrial metals, and prove either their identity or difference? No. The solar spectrum, when closely examined, gives us a multitude of fine dark lines instead of bright ones. They were first noticed by Dr. Wollaston, were investigated with profound skill by Fraunhofer, and named from him Fraunhofer's lines. They have been long a standing puzzle to philosophers. The bright lines which the metals give us have been also known to us for years; but the connection between both classes of phenomena was wholly unknown, until Kirchhoff, with admirable acuteness, revealed the secret, and placed it at the same time in our power to chemically analyse the sun.

We have now some hard work before us. Hitherto we have been delighted by objects which addressed themselves rather to our æsthetic taste than to our scientific faculty. We have ridden pleasantly to the base of the final cone of Etna, and must now dismount and march wearily through ashes and lava if we would enjoy the prospect from the summit. Our problem is to connect the dark lines of Fraunhofer with the bright ones of the metals. The white beam of the lamp is refracted in passing through our two prisms, but its different components are refracted in different degrees, and thus its colours are drawn apart. Now the colour depends solely upon the rate of oscillation of the particles of the luminous body; red light being produced by one rate, blue light by a much quicker rate, and the colours between red and blue by the intermediate rates. The solid incandescent coal-points give us a continuous spectrum; or in other words, they emit rays of all possible periods between the two extremes of the spectrum. They have particles oscillating so as to produce red, others to produce orange, others to produce yellow, green, blue, indigo, and violet respectively Colour, as many of you know, is to light what *pitch* is to sound. When a violin player presses his finger on a string he makes it shorter and tighter, and thus, causing it to vibrate more speedily, augments the pitch. Imagine such a player to move his finger slowly along the string, shortening it gradually as he draws his bow, the note would rise in pitch by a regular gradation; there would be no gap intervening between note and note. Here we have the analogue to the continuous spectrum, whose colours insensibly blend together without gap or interruption, from the red of the lowest pitch to the violet of the highest. But suppose the player, instead of gradually shortening his string, to press his finger on a certain point, and to sound the corresponding note; then to pass on to another point more or less distant, and sound its note; then to another, and so on, thus sounding particular notes separated from each other by gaps which correspond to the intervals of the string passed over. We should then have the exact analogue of a spectrum composed of separate bright bands with intervals of darkness between them. But this, though a perfectly true and intelligible analogy, is not sufficient for our purpose. We must look with the mind's eye at the very oscillating atoms of the volatilised metal. Figure these atoms connected by springs of a certain tension, and which, if the atoms are squeezed, together push them asunder, or if the atoms are drawn apart pull them together, causing them, before coming to rest, to quiver at a certain definite rate determined by the strength of the spring. Now the volatilised metal which gives us one bright band is to be figured as having its atoms united by springs all of the same tension, its vibrations are all of one kind. The metal which gives us two bands may be figured as having some of its atoms united by springs of one tension, and others by a second series of springs of a different tension. Its vibrations are of two distinct kinds. So, also, when we have three or more bands we are to figure as many distinct sets of springs, each set capable of vibrating in its own particular time and at a different rate from the other. If we seize this idea definitely we shall have no difficulty in dropping the metaphor of springs, and substituting for it mentally the forces by which the atoms act upon each other. Having thus far cleared our way, let us make another effort to advance.

Here is a pendulum—a heavy ivory ball suspended from a string. I blow against this ball; a single puff of my breath moves it a little way from its position of rest; it swings back towards me, and when it reaches the limit of its swing I puff again. It now swings further; and thus by timing my puffs I can so accumulate their action as to produce oscillations of large amplitude. The ivory ball here has absorbed the motions which my breath communicated to the air. I now bring the ball to rest. Suppose, instead of my breath, a wave of air to strike against it, and that this wave is followed by a series of others which succeed each other exactly in the same intervals as my puffs; it is perfectly manifest that these waves would communicate their motion to the ball and cause it to swing as the puffs did. And it is equally manifest that this would not be the case if the impulses of the waves were not properly timed; for then the motion imparted to the pendulum by one wave would be neutralised by another, and there could not be that accumulation of effect which we have when the periods of the waves correspond with the periods of the pendulum. So much for the kind of impulses absorbed by the pendulum. But such a pendulum set oscillating in air produces waves in the air; and we see that the waves which it produces must be of the same period as those whose motions it would take up or absorb most copiously if they struck against it. Just in passing I may remark, that if the periods of the waves be double, treble, quadruple, &c., the periods of the pendulum, the shocks imparted to the latter would also be so timed as to produce an accumulation of motion.

Perhaps the most curious effect of these timed impulses ever described was that observed by a watchmaker, named Ellicott, in the year 1741. He set two clocks leaning against the same rail; one of them, which we may call A, was set going; the other, B, not. Some time afterwards he found, to his surprise, that B was ticking also. The pendulums being of the same length the shocks imparted by the ticking of A to the rail against which both clocks rested were propagated to B, and were so timed as to set B going. Other curious effects were at the same time observed. When the pendulums differed from each other a certain amount A set B going, but the re-action of B stopped A. Then B set A going, and the re-action of A stopped B. If the periods of oscillation were close to each other, but still not quite alike, the clocks mutually controlled each other, and by a kind of mutual compromise they ticked in perfect unison.

But what has all this to do with our present subject?

[1] The vividness of the colours of the lithium spectrum is extraordinary. It contained a blue band of indescribable splendour. It was thought by many, during the discourse, that I had mistaken strontium for lithium, as this blue band had never before been seen. I have obtained it many times since, and my friend Dr. Miller, having kindly analysed the substance made use of, pronounces it chloride of lithium.—J. T.

They are mechanically identical. The varied actions of the universe are all modes of motion; and the vibration of a ray claims strict brotherhood with the vibrations of our pendulum. Suppose ethereal waves striking upon atoms which oscillate in the same periods as the waves succeed each other, the motion of the waves will be absorbed by the atoms; suppose we send our beam of white light through a sodium flame, the particles of that flame will be chiefly affected by those undulations which are synchronous with their own periods of vibration. There will be on the part of those particular rays a transference of motion from the agitated ether to the atoms of the volatilized sodium, which, as already defined, is absorption. We use glass screens to defend us from the heat of our fires; how do they act? Thus:—The heat emanating from the fire is for the most part due to radiations which are incompetent to excite the sense of vision; we call these rays obscure. Glass, though pervious to the luminous rays, is opaque in a high degree to those obscure rays, and cuts them off, while the cheerful light of the fire is allowed to pass. Now mark me clearly. The heat cut off from your person is to be found in the glass, the latter becomes heated and radiates towards your person; what then is the use of the glass if it merely thus acts as a temporary halting-place for the rays and sends them on afterwards? It does this:—It not only sends the heat it receives towards you, but scatters it also in all other directions round the room. Thus the rays which, were the glass not interposed, would be shot directly against your person, are for the most part diverted from their original direction, and you are preserved from their impact.

Now for our experiment. I pass the beam from the electric lamp through the two prisms, and the spectrum spreads its colours upon the screen. Between the lamp and the prism I interpose this snapdragon light. Alcohol and water are here mixed up with a quantity of common salt, and the metal dish that contains them is heated by a spirit lamp. The vapour from the mixture ignites and we have this monochromatic flame. Through this flame the beam from the lamp is now passing; and observe the result upon the spectrum. You see a dark band cut out of the yellow—not very dark, but sufficiently so to be seen by everybody present. Observe how the band quivers and varies in shade as the amount of yellow light cut off by the unsteady flame varies in amount. The flame of this monochromatic lamp is at the present moment casting its proper yellow light upon that shaded line; and more than this, it casts, in part, the light which it absorbs from the electric lamp upon it; but it scatters the greater portion of this light in other directions, and thus withdraws it from its place upon the screen, as the glass, in the case above supposed, diverted the heat of the fire from your person. Hence the band appears dark; not absolutely, but dark in comparison with the adjacent brilliant portions of the spectrum.

But let me exalt this effect. I place in front of the electric lamp the intense flame of a large Bunsen's burner. I have here a platinum capsule into which I put a bit of sodium less than a pea in magnitude. The sodium placed in the flame soon volatilizes and burns with brilliant incandescence. Observe the spectrum. The yellow band is clearly and sharply cut out, and a band of intense obscurity occupies its place. I withdraw the sodium, the brilliant yellow of the spectrum takes its proper place; I re-introduce the sodium, and the black band appears.

Let me be more precise:—The yellow colour of the spectrum extends over a sensible space, blending on one side into orange, and on the other into green. The term "yellow band" is therefore somewhat indefinite. I want to show you that it is the precise yellow band emitted by the volatilized sodium which the same substance absorbs. By dipping the coal-point used for the positive electrode into a solution of common salt, and replacing it in the lamp, I obtain that bright yellow band which you now see drawn across the spectrum. Observe the fate of that band when I interpose my sodium light. It is first obliterated, and instantly that black streak occupies its place. See how it alternately flashes and vanishes as I withdraw and introduce the sodium flame!

And supposing that instead of the flame of sodium alone I introduce into the path of the beam a flame in which lithium, strontium, magnesium, calcium, &c., are in a state of volatilization, each metallic vapour would cut out its own system of bands, each corresponding exactly in position with the bright band which that metal itself would cast upon the screen. The light of our electric lamp then shining through such a composite flame would give us a spectrum cut by dark lines, exactly as the solar spectrum is cut up by the lines of Fraunhofer.

And hence we infer the constitution of the great centre of our system. The sun consists of a nucleus which is surrounded by a flaming atmosphere. The light of the nucleus would give us a continuous spectrum, as our common coal-points did; but having to pass through the photosphere, as our beam through the flame, those rays of the nucleus which the photosphere can itself emit are absorbed, and shaded spaces, corresponding to the particular rays absorbed, occur in the spectrum. Abolish the solar nucleus, and we should have a spectrum showing a bright band in the place of every dark line of Fraunhofer. These lines are therefore not absolutely dark, but dark by an amount corresponding to the difference between the light of the nucleus intercepted by the photosphere, and the light which issues from the latter.

The man to whom we owe this beautiful generalisation is Kirchhoff, Professor of Natural Philosophy in the University of Heidelberg; but, like every other great discovery, it is compounded of various elements. Mr. Talbot observed the bright lines in the spectra of coloured flames. Sixteen years ago Dr. Miller gave drawings and descriptions of the spectra of various coloured flames. Wheatstone, with his accustomed ingenuity, analysed the light of the electric spark, and showed that the metals between which the spark passed determined the bright bands in the spectrum of the spark. Masson published a prize essay on these bands; Van der Willigen, and more recently Plücker, have given us beautiful drawings of the spectra, obtained from the discharge of Ruhmkorff's coil. But none of these distinguished men betrayed the least knowledge of the connection between the bright bands of the metals and the dark lines of the solar spectrum. The man who came nearest to the philosophy of the subject, was Angström. In a paper translated from Poggendorff's "Annalen" by myself, and published in the "Philosophical Magazine" for 1855, he indicates that the rays which a body absorbs are precisely those which it can emit when rendered luminous. In another place, he speaks of one of his spectra giving the general impression of reversal of the solar spectrum. Foucault, Stokes, and Thomson, have all been very close to the discovery; and, for my own part, the examination of the radiation and absorption of heat by gases and vapours, some of the results of which I placed before you at the commencement of this discourse, would have led me in 1859 to the law on which all Kirchhoff's speculations are founded, had not an accident withdrawn me from the investigation. But Kirchhoff's claims are unaffected by these circumstances. True, much that I have referred to formed the necessary basis of his discovery; so did the laws of Kepler furnish to Newton the basis of the theory of gravitation. But what Kirchhoff has done carries us far beyond all that had before been accomplished. He has introduced the order of law amid a vast assemblage of empirical observations, and has ennobled our previous knowledge by showing its relationship to some of the most sublime of natural phenomena.

ROYAL INSTITUTION OF GREAT BRITAIN.

Saturday, March 16, 1861.

A Course of Ten Lectures on Inorganic Chemistry, by Dr. Edward Frankland, *F.R.S., Lecturer on Chemistry at St. Bartholomew's Hospital.*

Lecture IX.

(*Concluded from page 54.*)

Now, these constituents of the atmosphere are not contained in the air in chemical union, but are present in a state of mechanical mixture. The oxygen and nitrogen are not chemically combined with each other, neither are any of the other constituents contained in this table [pointing to the first table given above] with the exception of the ammonia and nitric acid, or carbonic acid. When the air contains, at one and the same time, these substances, they combine, one possessing positive and the other negative energy; in other words, they act as an acid and a base, and exist in the form of a salt; but in all other cases the mixture is a purely mechanical one and not chemical. At one time it was very generally thought—at least many persons imagined—that the air was a chemical compound of oxygen and nitrogen, and even at the present day we sometimes meet with people who entertain this idea. But one of the facts which tells most against this theory is, perhaps, this:—If you agitate a quantity of atmospheric air with recently-boiled water, you will find that the atmospheric air contained in the vessel in which this agitation has taken place becomes richer in nitrogen and poorer in oxygen; that it now contains no longer the same per-centages of these two gases, but several per cent. more of nitrogen than it did before; and it is found also that the water has dissolved a certain quantity of the air according to the proportion in which the two gases, oxygen and nitrogen, exist in that air. You would find, also, on expelling that air again from the water, that it contained more than 30 per cent. of oxygen and less than 70 per cent of nitrogen. Now, we know of no instance in which a chemical compound can be in this way decomposed by mere solution in a solvent; therefore, it must be a mere mechanical mixture, for the oxygen is washed out from the nitrogen to such an extent as to render the remaining atmospheric air poorer in oxygen. We have also a further proof that the atmosphere is a mixture, by making artificially that mixture. We have here a vessel containing four volumes of nitrogen and one, of oxygen, which is about the proportion, as we have seen, of these gases in the air. Such a mixture has all the properties of atmospheric air, and animals can breathe it for exactly the same length of time as atmospheric air, and a taper can burn in it with exactly the same appearance; and, in fact, it has all the properties, physical and chemical, of atmospheric air. You see no difference in the combustion of this taper when it is lowered into the vessel; it exhibits the same appearance as when burning in the natural atmospheric air, although this is an artificial mixture.

But it may be asked, How is it, if the atmospheric air be a mechanical mixture, that these substances of which it is composed are all so uniformly mixed together, as to give us these almost identical results, as to composition, from whatever source we take our sample of air for analysis? How is it that gases possessing such different specific gravities as nitrogen, oxygen, ammonia, carbonic acid, nitrous acid, and bodies of this kind, do not separate in layers like oil and water? How is it that the nitrogen in the air does not ascend into the higher regions of the atmosphere, and the oxygen accumulate near the surface of the ground, and the carbonic acid form a thinner and distinct layer beneath the oxygen, because carbonic acid has a specific gravity about one-half more than that of air? Oxygen possesses a greater specific gravity than nitrogen, so that one might suppose that we ought to have layers of these two bodies—in fact, that we ought to have an atmosphere very similar to that which we shall have here if we place two jars, one containing oxygen and the other nitrogen, one above the other, the vessel containing oxygen being placed below, and that containing nitrogen being placed above. There is our jar of nitrogen, and this lower one is the jar of oxygen. I will endeavour to bring them over each other with as little agitation as possible, and then we will remove this plate from between the two gases. [The jars were arranged as stated.] Now, I think we have here these two gases in layers—the nitrogen above, which will, I think, put out our taper, and the oxygen below, you see, which re-ignites it. We do not get this result in the air, for we have, as we have said, the gases uniformly mixed. How is it that this mixture takes place? It has been found that whenever two gases of different specific gravities are placed in contact, even though we place the heavier gas below and the lighter gas above, the two gases will not for any length of time remain in this position; the heavier gas will ascend into the lighter gas above it, and the lighter gas from above will descend into the lower gas. What is termed "diffusion" will take place between those two gases. We have a simple arrangement here which will, I trust, illustrate this fact. Here are two common soda-water bottles which are united by a narrow glass tube, and they have been so united for several hours. The upper of these bottles contained hydrogen, and the lower bottle contained oxygen at the commencement of the experiment, when the bottles were filled some hours ago; so that, you see, we had in the upper vessel a gas which is sixteen times lighter than the gas contained in the lower one; and yet the heavier gas ascends through the narrow glass tube into the upper bottle, and diffuses itself into the lighter gas; whilst at the same time the light gas contained in the upper vessel makes its way, against gravity, downwards through this tube, and mixes with the gas in the lower bottle. By simply applying a light to the mouth of these bottles we shall find that we have an explosive mixture of oxygen and hydrogen which will manifest itself in the ordinary way. [A light was applied to the mouth of the upper bottle, and the contents burnt with a slight explosion.] You see from this that the hydrogen originally in that bottle was obviously mixed with oxygen which must have come up from the lower bottle; and we shall find that some of the hydrogen has gone down into the lower bottle. [A light was also applied to the mouth of the lower bottle with the same result as in the other case.] There also we have an explosive mixture, so that these gases, notwithstanding their very great difference of specific gravity, have yet mixed with each other through this very narrow tube.

Different gases diffuse in this way with different velocities. The lower the specific gravity of the gas, the greater the velocity with which it diffuses. These different velocities have been determined by Professor Graham, and the results are contained in the table which you have here.

Diffusion of Gases.

	Sp. Gr.	$\sqrt{\text{Sp. Gr.}}$	Diffusion Volumes.
Hydrogen	·0691	·2633	457
Ammonia	·5898	·7681	130
Air	1·000	1·000	100
Carbonic acid	1·5239	1·2345	81
Chlorine	2·4700	1·5716	64

I think that this difference in the diffusibility of gases may be clearly shown by a simple experiment. Here is a comparatively narrow glass tube terminating in a wider one, and the upper part of the wide tube is closed with a plug of plaster of Paris about half-an-inch in thickness. We will fill this compound tube with hydrogen by displacement; gradually withdraw this gas delivery tube and plunge the lower and open end of the compound tube into a coloured liquid, and now we shall have the hydrogen

rushing out and the air rushing in through this plug; but the hydrogen rushes out more rapidly than the air can get in, and consequently we have a rarefaction produced in the interior; and you see the effect of it in the rising of the coloured liquid, which is ascending very rapidly into the narrow tube, thus showing that the hydrogen is diffusing through that plaster of Paris plug much more rapidly than the atmospheric air, which is quite in accordance with the numbers in that table. Here is another experiment which illustrates the same thing to some extent. Here is a beaker, containing atmospheric air, which has been closed by means of very thin caoutchouc, and it is surrounded by a jar containing hydrogen which passes into the beaker to a much greater extent than the air gets out of the beaker. The hydrogen passes into the glass more rapidly than the air gets out, and the consequence is that we have a protuberance of the membrane which was at first perfectly flat. Here [exhibiting a similar beaker] we have the experiment inverted. This glass vessel was filled with hydrogen, and covered with a caoutchouc membrane. You see how the hydrogen has got out of the vessel more rapidly than the atmospheric air got in, and therefore this membrane is pressed into the jar to a very great extent.

Diffusion is one mode, then, by which the constituents of the atmosphere are kept mixed together, or prevented from separating into layers at all events. Then the mixture is rendered still more uniform, and any accumulation of gaseous matter at one particular place is rendered almost impossible, by atmospheric currents. I can only allude very slightly to the chief of them, namely, the trade winds, which, as you are aware, extend somewhat more than 30° on each side of the equator, and by means of which the atmospheric air from the temperate regions is carried into the torrid zone, and is then brought back again, by an upper current in an exactly opposite direction, into the colder regions. In this way there is a constant interchange of air between the Temperate, and even Polar regions, and the Tropics; and thus the whole atmosphere is kept in a state of constant mixture by the action of these trade winds.

But we have various operations going on in the atmosphere which must have a tendency, if they were not counteracted, to produce a gradual and permanent change in the comparative amount of each constituent. We have seen that combustion and respiration produce considerable quantities of carbonic acid gas; decay and putrefaction produce also immense quantities of the same gas. In the course of a single day by the combustion and respiration going on in London alone there are given into the atmosphere of our city no less than 150,000,000 cubic feet of carbonic acid. When we consider the vast extent to which these processes are going on all over the inhabited portion of the surface of the globe, we might be led to expect that the quantity of carbonic acid would be gradually increasing in the atmosphere; but there is another operation going on simultaneously, which tends in the opposite direction. This operation is the function of plants in taking carbonic acid from the air and restoring the oxygen of that carbonic acid. Just as animals, in breathing, take in the oxygen of the air, and give out carbonic acid, so plants take in by their leaves, which are really also their lungs, this very carbonic acid, and give out oxygen again in the same volume as it is contained in the carbonic acid which they absorb. Thus, whilst respiration, combustion and decay are sending into the air immense quantities of carbonic acid, all the green parts of vegetables are absorbing that carbonic acid, and restoring its oxygen into the atmosphere. Combustible substances remove oxygen from the air in forming carbonic acid, and the plants restore the same amount of oxygen back again into the atmosphere. By the simultaneous action of these two classes of processes, something like an equilibrium in the quantities of oxygen and carbonic acid present in the atmosphere at any one time is produced.

You will perceive from what I have just said that both the oxygen and the carbonic acid contained in the air have very definite functions to perform; but we have hitherto seen no use for the nitrogen contained in the atmosphere. The nitrogen would appear, if we look at it only superficially, to be quite a useless element. If the nitrogen were removed from the air, the same volume of atmospheric air would then contain exactly the same amount of oxygen as it does at the present moment, because the oxygen would spread itself out throughout the same space as it now occupies; therefore, if no nitrogen were present, you would have only the same amount of oxygen in a cubic yard of air as you have at the present moment; but still the relation of the atmosphere to combustion, and, no doubt, to respiration also, would be very different from what it is at present. In all cases of combustion in air the nitrogen takes up large quantities of the heat generated, and keeps down the temperature of the burning body, and this, in fact, prevents the combustion from becoming altogether uncontrollable. We have seen the difference between the burning of charcoal, for instance, and phosphorus, and other bodies, in pure oxygen and in atmospheric air; but you may say that if the oxygen were rarified in this way, the combustion would not proceed more rapidly or with greater intensity than it does when mixed with four volumes of nitrogen. We will just try this. Here is a receiver containing air which we will extract, and we will then fill the vessel with oxygen; when we have done that, we will pump out of it four-fifths of the oxygen that it contains, so as to leave in that receiver only the same amount of oxygen that there would be originally present in it when filled with air. Now we are admitting into that receiver a quantity of oxygen. [The jar having been filled with oxygen, the air-pump was applied until the oxygen was rarefied to a pressure of six inches.] We have there a pressure of only one-fifth of the atmosphere, or six inches of mercury. We have an arrangement in the inside of the receiver by which we can ignite a piece of phosphorus, and then you will see whether the phosphorus burns with anything like the same brilliancy as in oxygen at the ordinary pressure. Now that phosphorus is burning there in the oxygen which is only of the same density as the oxygen in atmospheric air. The result is strictly the same, and the light is quite as brilliant as if we were burning the phosphorus in oxygen of the ordinary density at the full pressure of the atmosphere. Thus it is the nitrogen, and the nitrogen alone, which reduces the temperature of combustion, and renders the ordinary combustion controllable. We might also show you by a similar experiment with watch-spring that the pressure of the oxygen does not affect the combustion, but we will forego that experiment, as it would occupy too much time.

Then, again, the atmospheric nitrogen reduces the rate of evaporation, by putting an additional pressure upon fluids. We should have water boiling at a temperature of about 150°, or even below that, if no nitrogen were present in the atmosphere; and the effect of that would be that we should have a far greater quantity of aqueous vapour in the air than we have at the present time. It is true that when saturated the atmosphere would not contain more vapour than it does now, but the point of saturation would be attained in far less time, and the atmosphere would be at all times, quite, or almost, completely saturated with aqueous vapour, if no nitrogen were present in it. I will show this by placing a vessel of warm water, at a temperature of about 150° under the receiver of the air-pump, and then exhausting the air to one-fifth the present pressure. The water is so little heated that I can bear my finger in it for a short time. When we reduce the pressure to the point I have mentioned, I think you will see that that water will boil. [The experiment was

performed accordingly, a violent ebullition of the water commencing upon the exhaustion of the receiver.]

Then, again, in one word, as I have expressed it here in the memoranda, the presence of nitrogen also contributes to the diffusion of light, and to the prolongation of twilight; and, finally, it adds mechanical effect to air currents. The wind would, in fact, be almost incapable of propelling our ships if it were deprived of more than three-fourths of its mechanical power.

We see, then, that there are many beautiful provisions for maintaining the composition of the atmosphere constant and invariable. We have diffusion to prevent it placing itself in layers; we have great atmospheric currents to mix together the different parts of the atmosphere so, as to prevent the effects of excess of vegetation on the one hand, and of combustion on the other. These different causes render the condition of the air almost constant as exhibited by the various experiments recorded in the table given above. Nevertheless, notwithstanding these beautiful arrangements, atmospheric air is frequently rendered impure, unwholesome, and unfit for the support of life. How is this? What are the chief causes of the contamination of atmospheric air? The air of towns, as we all know, is essentially different from the air of the country, and yet if submitted to analysis we get precisely the same results. It has been rather a reproach to chemistry that it has been unable to point out any difference between the air of towns and the air of the country, although human beings by living in those two atmospheres are perfectly aware of the very different effects produced by the difference. It is only during the last few years that any test has been devised, which could be at all relied on, by which any essential difference could be proved between atmospheric air in towns and in the country. This test we owe to Dr. Angus Smith who has applied it in a great variety of localities. The organic matter contained in the air really constitutes the difference between the air of thickly-populated districts and the free air of the country. The test which has been applied for its detection is the permanganate of potash, exactly the same test which was applicable to detect the organic matter in water. This very deeply-coloured solution is decolorized by organic matter present in the atmosphere. Here is a vessel containing very impure atmospheric air. We have rendered it, perhaps, abnormally impure, in order to show at a distance the result of the presence of organic matter for the purpose of the experiment. I will pour into this vessel containing the contaminated air some of this test, and agitate it. In that operation you see the solution is completely decolourized. This is the way in which Dr. Smith proceeds:—He takes a bottle of this size, fills it with atmospheric air, and adds this solution from a graduated burette, just as we proceeded when we were testing the water; and in this way he has obtained some very interesting results. This experiment gives you the relative quantities of oxidisable organic matter contained in the different specimens of air operated upon. The more of the oxidisable organic matter there is present in the air, the more of this test will be required for the purpose of producing a permanent colour. This organic matter is believed to be detrimental to health, and favourable to the spread of epidemic disease. Here are some of the results which have been obtained by the action of this test; they are the averages of a number of experiments.

Relative Quantities of Oxidizable Organic Matter in the Air of Various Localities:—

Grosvenor Square, Manchester	15
Same place, inside a laboratory	16
Ditto, when a trap of a drain was open	70
Back yard of the same laboratory	19
Second floor back bed-room at night	17
Ditto, morning, after being slept in by one person	20
Behind small dirty house on the river Medlock	27
Back yard of St. Michael's Place	140
Inside a clean house, St. Michael's Place	70
Front of same house	28
Crowded railway carriage	70
Manchester streets	52
Journey from Manchester into the country	36
" " "	30
" " "	27
" " "	19
" " "	12
High ground thirty miles from Manchester	6
In a piggery	94
Near a sewer stream. Very nauseous odour	73
On the Thames in summer when no odour was perceptible	50
London, W.C. district	26
London, N.W. district	33
Finchley	16
Camden Square, after a summer shower	10
Princes Street, Edinburgh	22
Lower parts of Edinburgh	40
Calton Hill, Edinburgh	12
Dry valleys of Switzerland	12
German Ocean, sixty miles from land	2·5
Great St. Bernard Pass	2·4

There were required for this normal quality of air in Grosvenor-square, Manchester, only 15 measures of this test to produce permanency in the colour of the solution. You see that the organic matter in the air of the laboratory, after it was contaminated by the sewer, was at once increased from 16 to 70. In a back yard in St. Michael's Place 140 measures of the test were required to produce the same amount of colour. In St. Michael's Place mortality has been very excessive, and whenever any severe epidemic prevails in Manchester, this locality is sure to be affected by it. Even inside a clean house in St. Michael's Place the number of measures required was 70. You will observe that there is a great difference between the front and the back of this St. Michael's Place, in the front only 28 measures of the test being required; and, consequently, it is possible for the people inhabiting that place, by a proper adjustment of ventilation, to bring down the per-centage of mortality considerably. Dr. Smith undertook a journey from Manchester into the country. Proceeding with the use of the test as he went on, he found that the number of measures required diminished in quantity as shown in the above table; and at last, when he had reached some high grounds 30 miles from Manchester, only 6 measures were required to produce a permanent colour. There are other results indicating the fact, that a piggery, if well kept, is considerably more healthy, as regards this organic matter, than some of the back yards of Manchester houses. Then follow results obtained in London, which do not call, perhaps, for any particular remark. And, lastly, we have some experiments made upon the German Ocean, sixty miles from land, and on the Great St. Bernard Pass, where we at last get a comparatively pure atmosphere. Although these results do not give us an absolute estimate of the organic matter, they show that there is a wide difference in different localities in respect to the amount of this matter contained in circumambient atmosphere.

Now these organic substances have, undoubtedly, a most important influence upon the health of the inhabitants; and we have invariably seen that where an improvement has been fairly tried, in respect to the drainage of towns, which has an important effect upon the air, it has had a most remarkable influence in reducing the mortality in those towns. Here is an instance upon this table showing such a result in the case of Croydon:—

Mortality per Thousand at Croydon.

1853	28
1854	26
1855	20
1856	17
1857	16

In Croydon, in the year 1853, the drainage was excessively bad, and at that time the mortality there was 28 per thousand per annum. In 1854 some little improvement was made—in fact, the drainage works were commenced, and the mortality was slightly less. In the year 1857, when the works were completed, the mortality was reduced to 16 per thousand, and has remained about that down to the present time. We may, therefore, regard the difference in the number of lives between 16 and 28 as absolutely saved by a better sewerage in that place. Here again we have similar results in the case of Ely:—

Annual Mortality per Thousand in Ely.

From 1843 to 1849	26
„ 1851 to 1855	20
1856	17
1857	17

You have again in another table a representation of the comparative mortality in many of our large towns:—

Of 1000 *Persons Living in the Following Places there Die Yearly:—*

In Liverpool	33
Manchester	31
Birmingham	27
London	24
Small towns and villages	20
Estimated normal death-rate	11

The estimated normal death-rate is only 11 persons in 1000 annually. From these tables you will be enabled to judge of the influence upon the atmosphere of these sewer emanations. While the gases escape as they do from the sewers into our atmosphere, they will undoubtedly exercise a most insalubrious effect upon the localities where they are let loose, and there cannot be a doubt that all improvements by which the gases are confined within the sewers, or are not allowed to escape into the atmosphere without passing through charcoal filters, such as are now being applied to some of the London sewers, would very considerably reduce the mortality of our large cities.

NOTICES OF PATENTS.

Treating Coal, and other Bituminous Materials, and Peat, for the Purpose of Obtaining Solid and Liquid Hydrocarbons. W. M. Williams.

This specification refers to an improved method of distilling coal and other bituminous minerals, under conditions of increased pressure, whereby the yield of paraffin, paraffin-oil, and other liquid and solid hydrocarbons is considerably augmented, as compared with processes of distillation at ordinary pressures, when the production of illuminating gas is the chief object of manufacture. The treatment of peat by the same process constitutes an additional claim under this patent, and is said to furnish similar products.

The process here described may be cited as an interesting example of the action of mechanical forces in determining the molecular arrangement of compound bodies. In the instance of the destructive distillation of coal, whether the hydrocarbons take the form of paraffin or illuminating gas, depends entirely on the physical conditions operating at the moment of production; these substances are but allotropic modifications of the same chemical compound, which, although identical in constitution, exhibit in their general characters widely different properties. In this respect the present specification bears a remote physical resemblance to the process of Mr. Young for producing paraffin from coal by distillation conducted at low temperatures.

Coating Metals and Metallic Alloys. W. Bagley and W. Mincher, Birmingham. (Not proceeded with.)

For the purpose of coating metals, such as iron or steel, with lead, or a metallic alloy composed of lead with a small quantity of copper, the inventors proceed to clean the surfaces of the original metal firstly by the process of scaling, and afterwards by immersion in dilute hydrochloric acid. When thus prepared, the sheet iron is subjected to the action of a mixed solution, containing chloride of lead in combination with the hydrochloric solution of arsenious acid; there it remains until a coating both of lead and arsenic is formed by reduction of these metals on the iron surface. Acting as a flux, this coating enables the iron to take lead freely, when the plate is afterwards dipped into a bath containing the latter metal in a molten state. The patentees prefer, however, to employ for the final coating, instead of pure lead, an alloy of lead with a small proportion of copper; and the article (plate or otherwise) is removed after dipping, cooled, and finished in the ordinary manner.

A practical trial would be necessary before a precise opinion could be given in regard to the necessity for employing an arsenical solution of so volatile a nature as that here recommended. Considering that arsenic plays so small a part in the ultimate composition of the metallic coating, it would be highly desirable in experimenting with this process to endeavour to avoid altogether the use of a poisonous agent, the fumes of which would certainly be prejudicial to the health of the workmen engaged.

Coating Metals and Alloys of Metals. W. Bagley and W. Mincher.

The patentees secured provisional protection, but did not proceed with another suggestion for the same object as the last. This consists in a preliminary preparation of the iron surface as before, and immersion in a solution of chloride of zinc; then, by galvanic agency, depositing upon the iron a coating of metallic zinc, which serves to facilitate the attachment of the lead when afterwards the article is dipped into a bath of molten lead, employed pure, or previously alloyed with a small proportion of copper.

It is a common practice to employ zinc for coating iron prior to its receiving a thicker surface of lead; and the chloride of zinc is also frequently used as a flux. The suggestion of employing an electro-deposit of zinc for this special application appears to be novel, but the advantage of the new process, especially in regard to expedition, does not seem manifest.

Insulating the Conducting Wires used for Telegraphic Purposes. W. Hirsch. (Not proceeded with.)

This specification refers to a method for securing the more perfect insulation of telegraphic wires by enveloping them in coils of spun glass, and afterwards filling up the capillary interstices between the vitreous fibres with resinous, tarry, or other non-conducting fusible material.

Glass, although one of the best insulating materials known, would, at the same time, we fear, be one of the most expensive. In the condition of spun filaments, its cost of production would be considerably augmented; and, unless it be proved that the resinous coating would itself afford additional protection, it is very questionable whether glass, in this state of division, could resist for any length of time the corrosive action of water.

An Improved Method of, and Machinery for, Amalgamating and for Effecting the Separation of Gold from Earthy and other Matters containing the same. B. G. Sloper. (Not proceeded with.)

This invention refers principally to a mechanical contrivance for assisting the action of the mercury in the process of extracting gold from crushed quartz and other rocks containing it. An Archimedean screw, and another working vertically, are kept in rotation by suitable machinery, and the apparatus is in part surrounded with a steam jacket, so that, by a more elevated temperature, the mercury may have its amalgamating powers to some extent augmented.

Preserving Organic Substances. W. Rattray, Aberdeen.

This patent refers to the application of sulphurous acid and its compounds with the alkalies and alkaline earths, as means of preventing the decomposition or decay of sundry vegetable and animal substances.

Considering that these agents have long been employed for checking the fermentation of beer, in the drying and preservation of hops, and in a few similar instances with well-tried efficacy, there is little doubt that the use of sulphurous acid for the purpose contemplated would be equally successful.

Filters. W. Clark. A Communication. (Not proceeded with.)

This specification describes the construction of a portable filter. It consists of an india-rubber bottle divided into upper and lower compartments by a porous plate or diaphragm of filtering material. Both extremities are provided with stop-cocks, that above being connected with the water supply-pipe. When in use the filtering bag or bottle is necessarily kept distended, so that the apparatus requires to be supported in a light frame work, but when dismounted the india-rubber collapses upon the porous diaphragm, and the whole arrangement occupies very little space.

CORRESPONDENCE.

Phosphorus Matches.

To the Editor of the Chemical News.

Sir,—In the *Chemical News* of July 27 there is a description of a well-corked bottle, coated internally with phosphorus. "But," says Mr. G. Gore, "It was not until 1833 that it (the phosphorus) was successfully applied (for lighting matches)." Now, Sir, there lived in Dublin, on the Quay, near the Four Courts, a chemist, who made his fortune in 1816 by the manufacture of precisely such bottles as Mr. Gore describes, and which never failed to give a light. William Kertland was the name of that chemist, and there are still living those who remember to have seen him in their youth jovially spending the Sunday evening at Quinn's Bray after a ramble through the Daryle at Powerscourt, so prosperous was his business.

I am, &c. Zamiel.

Salts of Manganese.

To the Editor of the Chemical News.

Sir,—Referring to an inquiry in a recent Number of the Chemical News, I beg to state that I am manufacturing "solid chloride of manganese," and should be obliged if you would inform your correspondent of this. I will furnish him with particulars on application.

I am, &c. B. W. Gerland.

Newton-le-Willows.

To the Editor of the Chemical News.

Sir,—I can supply your correspondent with any quantity of chloride of manganese, pure or commercial, crystallised or in large lumps. I am, &c. Wm. Lorberg.

Queen Street, Bermondsey, S.E.

On the Adulteration of White Lead.

To the Editor of the Chemical News.

Sir,—I am glad to see in your last Number of the Chemical News an *exposé* of the frauds in white lead. Some time ago I analysed a portion of white lead that came from a wholesale colour house near Cheapside, and it was adulterated 30 per cent. Shortly afterwards I had a sample sent me for analysation that came from a large manufacturer not far from Holborn Hill as "extra superfine," and it was adulterated 32 per cent. In both instances the principal of the firm admitted that they were adulterated, but excused themselves by saying that it was a mistake of the warehousemen.

I had occasion to analyse some linseed oil that came from a City crusher, and it was mixed with 20 per cent. of resin oil.

Trade has now become a system of adulteration, and that manufacturer who is the cleverest at adulteration is the one who makes the largest fortune and secures the greatest trade. I am, &c.

Geo. Jas. Johnson.

258, High Street, Chatham, and Beacon Hill, Luton.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Perchromic Acid.—Aschoff (*Journal für prakt. Chemie*, Bd. lxxxi. s. 401) confirms the existence of a definite acid Cr_2O_7 formed when binoxide of nitrogen acts on a dilute solution of bichromate of potash. The blue compound formed in this reaction is, as our readers know, soluble in ether, and when the etherial solution is shaken with a dilute solution of potash added in such a quantity that the blue colour is hardly apparent, the aqueous solution which separates is of a deep violet-brown colour, and perfectly neutral. It becomes again blue on the addition of an acid, but an excess of potash completely decomposes it, just as in the case of the acid Mn_2O_7. The colouring power of perchromic acid is immense, a decigramme being sufficient to give a deep blue colour to 500 cub. cents. of water. The author could not obtain a definite salt with the acid.

Permanent Source of Ozone.—Boettger says (*Zeitschrift für Chem. und Pharm.*, Bd. iii. s. 718) that a mixture of two parts of permanganate of potash and three parts of sulphuric acid forms a pasty mass, which will continue to give off ozone for several months.

Preparation of Permanganate of Potash.—Boettger recommends the following process, (*Ibid.*)—Fuse together in an iron crucible, 4 parts of hydrate of potash, and 2 parts of chlorate of potash, and when oxygen begins to be evolved remove the crucible from the fire, and stir in gradually one part of peroxide of manganese. Heat again until the mixture solidifies, after which boil it with 80 parts of water, and then pass carbonic acid until the liquid becomes red. The solution is now decanted, filtered through gun-cotton, evaporated to one-half and set aside to cool, whereupon large crystals of the permanganate are obtained.

Artificial Chalybeate Water.—Hauer points out (*Journal für prakt. Chem.*, Bd. lxxxi. s. 391) that reduced iron dissolves with facility in a solution of carbonic acid, the solubility increasing, of course, under pressure, and being diminished by the presence of alkaline carbonates

in the water. Our readers ought to know, however, that the above way of making chalybeate water has been patented in England for a year or more.

II. ORGANIC CHEMISTRY.

Purification of Acetic Ether.—The following method of rectifying acetic ether is given by Engelhardt (*Zeitschrift für Chem. und Pharm.* Bd. iii. s. 618): The rough product contains free acetic acid and alcohol. In consequence of the presence of the latter, it is soluble in an equal volume of water; but when pure, it requires at least seven times its volume to dissolve. The author's process is based on this fact. He begins by neutralizing the acetic acid with calcined magnesia, he then dilutes with an equal volume of water, and afterwards adds sufficient common salt to make a saturated solution. When no more salt dissolves, the whole is shaken up, and then allowed to rest, whereupon the mixture separates into two layers, the lower of which is a saturated solution of common salt in dilute spirit, and the upper acetic ether nearly anhydrous (0·89) and quite pure. No further rectification is necessary.

New Compound by the Action of Hydrogen on Nitrobenzine.—Jumel (*Bulletin de la Société Chimique de Paris*, No. II., p. 47), passed simultaneously dry hydrogen and the vapour of nitrobenzine over platinum black contained in a porcelain tube and heated. At first white vapours were copiously produced, then these ceased and a yellowish-brown oil condensed and fell to the bottom of the water in the receiver. After some time the production of this oil stopped, very heavy yellow vapours passed, and then a large quantity of thick, black oil condensed. In several experiments the same phenomena presented themselves in the same order. The yellow oil dissolved in acetic acid, the solution treated with hypochlorite of lime gave a dirty violet-red colour like wine lees; bichromate of potash produced no colour. Tested with the hypochlorite and without acid, it gave a blue colour, dirty at first, but which deepened in time, and eventually looked like an alkaline solution of sulphate of copper. This blue colour, the author found, was reddened by acids and restored by alkalies just like litmus. The blue matter is soluble in water and alcohol, and dyes, but the colour washes out. The black oil obtained, the author found to be only a product of the decomposition of vapour of nitrobenzine heated to about 400° C.—for after a time the platinum becomes covered with carbon and does not act.

Veratric Acid = $C_{18}H_{10}O_8$, according to W. Merck, yields with strong nitric acid yellow nitro-veratric acid $C_{10}H_9NO_{12}$, which is soluble in water, crystallizes from alcohol and yields binitroveratric acid with more NO_5. By heating moderately with 3 parts of baryta, veratrol = $C_{16}H_{10}O_4$ is obtained, which has an aromatic odour, crystallizes at 15° (59° F.), possesses the specific gravity of 1·086, boils between 202° and 205° (396° to 401° F.); it yields with fuming nitric acid nitro- and binitroveratrol, and with bromine bibromoveratrol = $C_{16}H_8Br_2O_4$—*Annal. der Ch. und Ph.* xxxii. 58—62.

III. ANALYTICAL CHEMISTRY.

Estimation of Iodine in Tincture.—Ranwez (*Polytech. Notizblatt*, Bd. xvi. s. 47) shakes the tincture with a known weight of granulated zinc. When the solution is colourless, he separates the metal that remains, drys, and weighs it. The amount of iodine is calculated from the loss. Pure zinc must, of course, be employed.

IV. TECHNICAL CHEMISTRY.

Extraction of Silver from Galena.—Sulphide of silver and chloride of lead mutually decompose when fused together. The reaction has been applied with success to the extraction of silver from galena. The galena is mixed with one per cent. of chloride of lead and ten per cent. common salt, and the mixture is fused. Chloride of silver is formed, and, together with the chloride of sodium, swims on the surface, forming, when cold, a crystalline crust, which is easily separated. The crust will contain an excess of chloride of lead. The reduction of the metals may be proceeded with in the ordinary way.—*Polytech. Notizblatt*, s. 95.

MISCELLANEOUS.

Practical and Theoretical Chemistry. — The labours of physiological chemists have pretty well settled the general principle, that the material by which our bodies are sustained, may be conveniently arranged under the heads of blood-producing food, and food which is principally consumed, during the process of respiration, in generating animal heat. The blood-producing food, consisting chiefly of albumen, fibrin and casein, contains nitrogen; while the heat-producing food is devoid of that element, Very complicated formulæ are assigned to the blood-producing principles, giving, according to some authorities, more than one hundred equivalents to two of their elements, namely, carbon and hydrogen. Such formulæ cannot be supported by analysis with any show of probability. Nevertheless, they are chemists, who take these improbable formulæ as proved; and venture to trace the transformations which the blood-producing principles of the food undergo, during their conversion into blood. Thus, they say, that casein, with a certain proportion of water, may yield blood-albumen and chondrin, the latter being the principle of cartilage; and, again, that two equivalents of albumen and two of water are equal to one equivalent of blood-fibrin, one equivalent of choleic acid, and one equivalent of gelatin. The equations here given are true equations, on the assumption that the composition of the substances concerned is correctly represented; but this assumption is wholly gratuitous. Admitting, however, that the analyses are correct, can it be believed that equations like these represent the truth of nature? These chemists, drawing on their fancy, do not hesitate to make any transformation that may suit their theories. If they have too much oxygen to suit their views, oxygen is alleged to be given off; if there is present too much of both oxygen and hydrogen, then water is formed; and, if carbon is redundant, they do not hesitate to say that the portion in excess is removed, in the form of carbonic acid, by the oxygen of the air! This scientific facility reminds us of an anecdote which is related of one of our Commissioners of Patents, who was in office about the beginning of the present century. He was a man of general information, but had no pretensions to a knowledge of science; and, in his own opinion, everything was easy to accomplish. Being simple-minded and credulous, he was easily imposed upon. A wag applied to him for a patent for making boards out of sawdust. "Oh! my friend," said the Commissioner, "that art has long been known, and is very easy." "But," said the applicant, "I fear, sir, you do not exactly understand my purpose. My invention consists in making *pine* boards out of *oak* sawdust." "Oh! is that it," rejoined the Commissioner; "but that is very easy also, for you have only to add a little turpentine!"

ANSWERS TO CORRESPONDENTS.

W. X. Y.—The sample of oil which you have sent is largely adulterated with olive oil, and is not worth a quarter the sum you name.

Y. C. Bell.—Steel beams of balances can be protected from injurious fumes of the laboratory by being lacquered, or better still by being electro-gilded. For a small blast furnace apply to Griffin and Co., Bunhill Row.

J. D. Perrins.—We will inquire, and communicate with you.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Exact Separation of the Ethyl Bases,[1] *by M.* CAREY LEA, Philadelphia.

IT has been known for some time that when ammonia was acted upon by the halogen ethers, the ethylamine produced was always accompanied by a variable quantity of the secondary and tertiary ethyl bases and the ammonium base, and I have shown that the same is the case with respect to the secondary and tertiary ethyl bases in the reactions of oxy-ethers. The ammonium base I have not looked for, but it is, doubtless, present also. The primary, secondary, and tertiary bases resemble each other so closely in their properties, that their separation is attended with great difficulty, and has generally been effected by the different solubilities of their chloroplatinates.[2] I find, however, that it may be accomplished with great ease by means of picric acid. The picrates of the different bases exhibit the most opposite degrees of solubility, the picrate of triethylamine rivalling the picrate of potash in insolubility, while that of diethylamine is soluble to an almost unlimited extent in water, alcohol, and ether, without being in the least deliquescent. Its affinity for ether is so great that its concentrated etherial solution will remain exposed to the atmosphere for days in a syrupy condition, gradually crystallising on the surface, and eventually all through, to a radiated mass. Between these two extremes the picrate of ethylamine occupies an intermediate position, and the differences of solubility are so well marked as to render the separation perfectly easy in the manner to be indicated below.

1. *Separation of the Mixed Bases from Ammonia.*

This has been generally directed to be done by treating the mixed hydrochlorates either with absolute alcohol, or with a mixture of strong alcohol and ether, whereby the sal ammoniac is supposed to be left undissolved.

This process I have always found to the last degree unsatisfactory, and necessarily so; for if absolute alcohol be allowed to stand over sal ammoniac in powder for a time and then be evaporated in a watch-glass, a certain quantity of sal ammoniac will be deposited, and the same is true of a mixture of strong alcohol and ether. By operating on the ammonias in the form of sulphates, a much more satisfactory result is obtained. For this purpose the mixture as poured out from the pressure-tube is treated with a sufficient quantity of pure sulphuric acid to displace the nitric acid (or if bromide or iodid of ethyl have been employed, the bromhydric or iodhydric acid), and the solution is evaporated as far as possible at a temperature of about 250° F. The pasty mass is exhausted with strong alcohol, the alcoholic solution is evaporated as far as possible at the same temperature, and the residue exhausted with a small quantity of absolute alcohol. Two exhaustions at least are necessary, even when absolute alcohol is used the first time. In this way a satisfactory result is obtained, which cannot be accomplished with the chlorhydrates.

2. *Separation of the Mixed Bases from each other.*

TRIETHYLAMINE.

After being completely freed from ammonia, as above described, the mixed sulphates were distilled with caustic potash, in the usual way, and the bases were saturated with crystallised picric acid. Sufficient heat was applied to re-dissolve the precipitate which formed toward the close of the saturation, and the hot (not too concentrated) solution allowed to crystallise. The first crop of crystals thus obtained were purified by several re-crystallisations, the chlorhydrate of the base was formed, and from this the chlorplatinate, which was obtained in large and beautiful crystals. The platinum salt was analysed.

·4858 grammes substance gave ·1567 platinum,

	Per cent.
This corresponds to	32·26

Chloroplatinate of triethylamine contains 32·23.

The close correspondence of the result with the number given by theory indicates the perfect purity of the triethylamine. Its proportion is but inconsiderable compared with that of ethylamine and diethylamine, and it is chiefly contained in the first portion of the gaseous products which pass over in the distillation with caustic potash.

Picrate of triethylamine crystallises in delicate yellow needles, which dissolve sparingly in cold water and alcohol, abundantly in hot. The decrease of solubility in an aqueous or alcoholic solution as it cools is very sudden, so that a hot solution deposits almost the whole of the salt as it begins to cool. Placed on platinum foil and gently heated, it melts, turns first red, then black, at the same time boiling up, takes fire, and leaves a residue of charcoal.

ETHYLAMINE.

After the least soluble salt had been removed in the manner just described, the mother-water deposited another crop of crystals, which were purified by repeated re-crystallisation, the chlorhydrate of the base was formed, and its chlorplatinate was analysed.

·4429 grammes substance gave ·1728 platinum.

	Per cent.
This corresponds to	39·02

Chloroplatinate of ethylamine contains 39·29.

Picrate of ethylamine presents great differences of appearance according to accidental circumstances. When first crystallising out of the mixed solution, it usually forms groups of short, brown prisms, adhering to the bottom of the basin. If these be re-crystallised, we obtain long, yellow, flattened prisms and laminæ, extending in every direction through the liquid; few substances

[1] *American Journal of Science and Art.*

[2] Dr. Hoffman has lately described an elegant mode of separation, differing, however, entirely from that here proposed,—viz, by means of oxalic ether.

exhibitmore beautiful crystallisations. A dilute alcoholic solution often deposits flat prisms, bevelled at the extremities, and sometimes hexagonal plates.

In solubility in water this substance approximates to the picrate of ammonia, to which, after it has been subjected to repeated re-crystallisations, it bears considerable resemblance in appearance.

DIETHYLAMINE.

After the picrate of ethylamine has been for the most part removed, the mother-waters exhibit a curious phenomenon, which greatly simplifies the further purification of the diethylamine salt left in solution. When these mother-waters have been a little reduced by spontaneous evaporation, or by a gentle heat, the liquid spontaneously separates into two layers, a pale yellow, lighter, and a dark brown, heavier. The evaporation is continued until the heavier layer constitutes rather more than half of the whole, and then the two layers are separated, either at once by a separating-funnel, or ether may be added and thoroughly shaken up, when the brown layer dissolves in the ether and rises to the top. After separation it is allowed to crystallise and is once or twice re-crystallised from a small quantity of ether, by which it is obtained quite pure. A specimen was converted into chlorhydrate and then into chlorplatinate, and gave the following results on analysis:—

·3884 grammes substance gave ·1377 platinum.

	Per cent.
This corresponds to	35·45
Chloroplatinate of diethylamine should contain	35·45.

It appears, therefore, that the salt obtained in the above-described manner is perfectly pure.

Picrate of diethylamine, without being deliquescent, is soluble to almost any extent in water, alcohol, and ether. By spontaneous evaporation, it crystallises in a radiated mass. Sometimes at the bottom of the vessel beautiful transparent brown-yellow crystals form, which belong to the monoclinic system. Combination observed $\infty P \infty$, $[\infty P \infty]$, oP, ∞P, $+P$, and a clinodiagonal doma.

The approximate proportions in which the different ethyl bases were produced by the reaction here made use of were, perhaps, ten per cent. of triethylamine, thirty or forty of diethylamine, and fifty or sixty of ethylamine.

The method here described gives with facility a very exact separation of these bases. The only precaution necessary to be observed, especially in operating on small quantities, is, that the solution must not be too concentrated at the outset, otherwise the picrate of triethylamine will be mixed with picrate of ethylamine. But the delicate needles of the former are easily distinguished from the broader ones and prismatic crystals of the latter, and two or three re-crystallisations suffice to separate them completely.

I feel assured that picric acid will be found to be a most valuable re-agent in effecting separations of cognate organic bases. It may be doubted if there exists any other acid whose salts, taken as a whole, exhibit so marked a tendency to ready crystallisation, and the great differences in the solubility of picrates of allied bases adds, as in the foregoing example, to the value of this acid in effecting separations between them.

On Didymium, Lanthanum, Cerite, and Lanthano-Cerite, by R. Hermann.

P. Hermann has studied the preparation of the oxides of cerium, lanthanum, and didymium. These oxides are still often separated, according to Mosander's process, with diluted nitric acid, and crystallising the sulphates of lanthanum and didymium. The substances thus prepared are, however, never perfectly pure.

After treating the oxides with dilute nitric acid, the undissolved protoxide of cerium is best purified by solution in sulphuric acid, mixing the concentrated solution with much water, and then heating, by which means perfectly pure sulphate of cerium is separated.

In order to purify the oxides of lanthanum and didymium perfectly, advantage may be taken of the circumstance that oxide of lanthanum is a more powerful base than oxide of didymium.

With this object the two substances are first separated by the crystallisation of their sulphates. This operation is facilitated by the fact that sulphate of lanthanum is more difficultly soluble than sulphate of didymium. From a concentrated solution of the two salts prepared in the cold, sulphate of lanthanum separates out first on the application of heat, while the sulphate of didymium remains for the most part in solution. This solution is then evaporated at the temperature of the air to dryness. A mixture is thus formed of crystals of sulphates of didymium and lanthanum. When these are treated with cold water, the sulphate of didymium is dissolved in preference, while the sulphate of lanthanum, which, in the crystallised state, is very difficultly and slowly soluble in a concentrated solution of sulphate of didymium, remains to a great extent behind. This solution of sulphate of didymium is again suffered to evaporate to dryness, and the sulphate of didymium is once more dissolved in cold water. This operation must be repeated as long as sulphate of lanthanum continues to separate. Finally, by these crystallisations tolerably pure sulphates of lanthanum and didymium are obtained.

In order to purify these salts completely, a portion of each solution is precipitated with ammonia, and the precipitates well washed. These precipitates are then mixed with the remaining portion of the same salts and allowed to remain a few days at a gentle heat, with frequent stirring.

If impure sulphate of lanthanum has been so treated, the basic sulphate of lanthanum precipitates the sulphate of didymium still present in the solution completely, and there remains nothing but sulphate of lanthanum in solution, which can be crystallised by the evaporation of the solution.

If, on the other hand, impure sulphate of didymium has been employed, the basic sulphate of lanthanum dissolves perfectly in the liquid, and basic sulphate of didymium is precipitated. After a few days the sediment will consist of nothing but pure basic sulphate of didymium. This may be collected on a filter, dissolved in sulphuric acid, and crystallised.

Examination of some Didymium Compounds.—The compounds of didymium were examined by Mosander, and subsequently very fully by Marignac. Marignac fixed the atomic weight of didymium at 600[1], according to the author it is 593·5.

Oxide of Didymium, obtained by precipitating the sulphate with oxalate of ammonia, heating the oxalate to redness, in the presence of air, and subsequently strongly heating the peroxide so obtained in a covered crucible, appears as white pieces with an earthy fracture, sp. gr. 6·54. By treating peroxide of didymium in a

[1] The oxygen = 100 scale is adopted throughout this paper.

current of hydrogen, it forms white pieces of the texture of the peroxide. It consists of

Di	85·58
O	14·42
	100·00

Peroxide of Didymium, prepared by heating nitrate of didymium in the air, forms a silky-looking, spongy mass of a brown colour. By heating the oxalate in the air, with constant stirring, it is obtained in the form of a chesnut-brown powder. Heated in a current of hydrogen, it alters its colour immediately from brown to white, water being formed at the same time. On the other hand, the white oxide immediately becomes brown when heated in the air.

If peroxide of didymium is heated in a covered platinum crucible, so that the crucible lies deep in the flames, and all access of atmospheric air be thus cut off, the action of the deoxidising gases of flame, however, being facilitated, a perfect reduction to the state of white oxide takes place. If the peroxide be dissolved in the oxygen acids, it is reduced with evolution of oxygen to the white oxide. With hydrochloric acid it evolves a small quantity of chlorine.

The composition of peroxide of didymium may be very accurately determined; if a weighed quantity be treated in a close vessel with the solution of the iodide of potassium in diluted hydrochloric acid, and then be allowed to dissolve perfectly, iodine is thus set free as an equivalent of the oxygen which the peroxide contains more than the protoxide. With standard solutions of hyposulphite of soda and iodine, the quantity of iodine set free may be determined. In this way 100 parts of peroxide of didymium set free 7·070 of iodine, which expresses 0·446 oxygen. According to this, the composition of peroxide of didymium may be expressed by the formula $Di_{32}O_{33}$:—

Di	85·20	32 = 18992·0	85·19
O	14·80	33 = 3300·0	14·81
	100·00	22292·0	100·0

Attempts to prepare a peroxide of didymium containing a greater proportion of oxygen met with as little success with the author as with Marignac. When a previously-fused mixture of nitrate of didymium and nitrate of potassium was projected into a fused mixture of chlorate of potassium and hydrate of potassium, a brown oxide was obtained, which by the iodine test yielded exactly as much iodine as the peroxide prepared by heating the nitrate of didymium. Also, when peroxide of didymium was treated with a quantity of nitric acid insufficient for complete solution, an oxide remained behind of the same composition as it was before this treatment. Peroxide of didymium, as well as the protoxide, dissolves easily, and with evolution of heat, in sulphuric, nitric, hydrochloric, and acetic acids, and forms with these acids rose-red solutions, which are precipitated white by phosphoric and oxalic acids, and by ferro-cyanide of potassium. With the help of the blow-pipe the oxides of didymium form with borax, both in the outer and inner flame, rose-coloured glasses. The oxides of didymium are dissolved by phosphates with greater difficulty than by borax. A glass is formed in this case that easily becomes turbid from a white deposit; it shows, however, when strongly saturated, a distinct rose coloration. The blue colour mentioned by Mosander was only remarked by the author when the oxide of didymium contained cobalt.

(To be continued.)

On the Production of Graphite by the Decomposition of Cyanogen Compounds, by Dr. P. Pauli.

The mother-liquors obtained from the evaporation of a solution of the so-called black ash are now commercially marked for caustic alkali. These liquors contain the following compounds:—

1. Chiefly hydrate of soda.
2. Some quantity of carbonate of soda.
3. Several sulphur compounds of sodium,—viz., sulphide of sodium, hyposulphite of soda, sulphite of soda, and sulphate of soda.
4. Sulphide of iron held in solution by the sulphide of sodium.
5. Chloride of sodium.
6. Several cyanogen compounds of sodium, and especially ferrocyanide of sodium.

These liquors are evaporated in large cast-iron pots, and in order to destroy or oxidise the sulphides of sodium and iron, as also the cyanogen compounds, an equivalent quantity of soda-saltpetre is added. All the oxidable sulphur compounds, together with the small quantity of sulphide of iron, are changed to sulphate of soda and peroxide of iron by the nitrate of soda in the boiling liquid at a temperature not below 260° to 270° F. The cyanogen compounds, on the other hand, are not decomposed by the nitre until the liquor begins to pass from the watery into the dry fusion, and the uncombined water of the hydrate of soda has been driven off. When the whole mass of alkali (generally about four tons) reaches a low red heat, a regular evolution of gas is observed: this is evidently owing to the oxygen produced by the decomposition of the nitrate and to the nitrogen from the decomposition of the cyanides; at the same time, a plentiful liberation of graphite is observed, covering the whole surface of the liquor with a bright layer of graphite. This liberation of graphite is still more plainly seen if no nitre be added to the liquor at first, or only so much as is sufficient to oxidise the sulphur compounds; but if a few pounds of nitrate of soda be added when the water has been driven off, and the mass is allowed to become red-hot, a violent reaction takes place, and a large quantity of graphite is set free. This sudden liberation of graphite proves that this substance cannot be derived from the cast iron of the pot in which the fusion is made. So violent is the evolution of gas that a complete cloud of fine particles of caustic soda is carried up into the air, rendering it almost impossible to remain in the neighbourhood of the operation. In this way all the cyanogen compounds are completely decomposed, the iron in the ferrocyanide of sodium becomes peroxide, and in a few hours falls to the bottom of the pot. If the right quantity of saltpetre has been added, a colourless mass of fused caustic soda remains; but if too large an amount of nitre has been added the liquor becomes coloured deep green, owing to the formation of manganate of soda. It is remarkable that, in the absence of nitrate of soda, the cyanogen compounds act reducingly upon the sulphide of sodium. This is seen from the fact that a portion of the soda-lye, which gives no sulphide reaction with a lead salt, produces a blackening after the caustic alkali has been heated to redness.

The graphite may be skimmed off the surface of the fused alkali, and when washed with water and hydrochloric acid it appears in the form of an extremely fine, bright powder. If allowed to swim on the top of the almost red-hot fused soda, the graphite is oxidised gradually, and, after the lapse of about three or four

hours, it altogether disappears. Heated in a platinum crucible by itself, it is incombustible; but it generally contains small particles of charcoal mixed with it, and these undergo oxidation.

The temperature at which this evolution of graphite takes place is a very low one compared with that at which graphite is liberated from cast iron; for a thin iron wire can scarcely be brought to a visible red heat by dipping it into the fused alkali.

From this peculiar decomposition, it would appear that we have good reason to assume that the carbon contained in cyanogen is present in the graphite modification; for if this be not the case, how is it that the easily-combustible charcoal can withstand the oxidising action of the saltpetre, whilst none of the iron of the ferrocyanide of sodium has been reduced to the metallic state?

It has, besides, been lately shown by M. Caron that the formation of steel—*i. e.*, the combination of iron with carbon in the graphite modification—can only take place in presence of cyanogen compounds, and that no carbon whatever is taken up by the iron when this metal is heated with other carboniferous gases. The mode of production of graphite noticed in this communication appears to be an intermediate reaction between that from the carbide of iron and from the nitride of carbon.

As in the process of cementation, it is seen that the carbon of the cyanogen is taken up by the iron without being set free; so this reaction proves that cyanogen can be split up into its constituent parts without either of them combining with a third body.

Despretz asserts that the carbonisation of iron is always preceded by a combination of this metal with nitrogen,—a process which makes it porous and more fit for uniting with carbon. The correctness of this supposition has, however, become rather doubtful by Caron's recently-published experiments (*Comptes-Rendus*, 1860).

To conclude, I beg to say some words about the formation of native graphite. I do not think that this body has been formed from coal or diamond, but I rather believe it has been separated out of carbon compounds as graphite by processes perhaps analogous to those above described.—*Proc. Manchester Phil. Soc.*

On White Lead, by WILLIAM BAKER, *F.C.S.*

THE following observations on the composition of white lead, in addition to those published in a recent Number, may not be uninteresting to your readers. My analyses refer to Dutch white lead, or carbonate of lead containing some hydrate of lead produced by means of acetic acid and spent tan, and it will be seen that no fixed and definite formula can be written for the commercial dry white lead. It is rather a carbonate, containing a variable proportion of hydrate, that depends upon the conditions under which the corrosions are produced. Thus, in a single bed of corroded lead a number of samples may be selected all varying in the proportion of carbonate to hydrate. Near the side walls, where the aqueous vapour, loaded with carbonic acid, freely ascends, it will be found that, under some circumstances, corrosions of a sugary character are produced, which, upon examination, are found to be a mass of minute transparent crystals of neutral carbonate of lead. Again, on the surface of the corrosion, a thin, scaly layer sometimes separates, which is also near in composition to the neutral carbonate. The quantity and quality of the water employed in grinding and washing the corrosions to a pulp, doubtless influences the ultimate composition of the dry white lead, especially as the water usually contains free acetic acid and acetate of lead obtained from the corrosions. In proof of this, I submit the following analyses of dry white lead from different manufactories, which agree very well with those published by Professor Mulder:—

	No. I.	Calculated.	Equivalent.
CO_2	11·03	11·4	= 2
HO	2·23	2·3	= 1
PbO	86·11	86·3	= 3

	No. II.	Calculated.	Equivalent.
CO_2	12·17	12·7	= 3
HO	1·66	1·7	= 1
PbO	85·37	85·6	= 4

	No. III.	No. IV.	Calculated.	Equivalent.
CO_2	13·37	13·48	13·4	= 4
HO	1·11	1·46	1·4	= 1
PbO	84·71	84·88	85·2	= 5

The hygroscopic water is generally not more than 0·050 per cent.

No. 1, London white lead; No. 2, Newcastle ditto; Nos. 3 and 4, Sheffield ditto.

I do not mean to assert that the product of these manufactories is always of the same composition; for I have made analyses of the Sheffield white lead in which the oxide of lead comes up to 86 per cent. The other constituents were not estimated; but this is sufficient to show that it was then near the composition of the London sample, No. 1. This variation in the manufactured white lead will be still better understood on consideration of the following analyses of corrosions. These have been selected to show the variability of their composition, although Nos. 1. and 11. may be considered of the normal kind.

No.	CO_2.	HO.	PbO.
1. Good solid corrosion	12·49	1·60	85·24
2. „ „	12·31	1·72	85·77
3. Shelly surface of corrosions	15·14	0·53	83·86
4. Hard, flaky corrosion	15·14	0·60	84·10
5. Colourless, crystalline, and transparent corrosions	15·71	0·75	83·53
6. Colourless, transparent crystals, picked out from a mass of sugary corrosion	16·11	0·49	83·39
7. Calculated neutral carbonate	16·50	—	83·50

It will be seen that Nos. 5 and 6 are evidently the neutral carbonate containing only a trace of hydrate. Nos. 3 and 4 illustrate the passage from the latter to the normal corrosion, which may be represented, if a formula is desired, by $PbOHO + 3PbOCO_2$.

Lead Works, Sheffield.

On Ozonised Hydrogen and Oxygen, by M. H. OSANN.[1]

THE hypothesis having been published, that the author's ozonised hydrogen might derive its more energetic reducing power from the production of one of the inferior acids of sulphur accompanying the hydrogen disengaged from the voltaic battery, M. Osann endeavoured to find whether this explanation was tenable. After passing a current of ozonised hydrogen during an hour through a certain quantity of water, he found that the water remained neutral, which would not be the case supposing the gas were mingled with an acid of sulphur.

[1] *Journal für Praktische Chemie*, vol. lxxxi., p. 20, 1860, No. 17.

He then wished to take account of the relative quantities of ozonised hydrogen absorbed by a solution of silver, and of the reduced silver. Electrolytic hydrogen, twice washed in distilled water, was left for some time over a solution of nitrate of silver. The gas was measured before and after absorption, and the tension of the water vapour estimated, and the reduced silver weighed. This silver did not contain the slightest trace of sulphur, which is also in contradiction to the hypothesis in question. It has been found that on an average 100 cubic centimètres of absorbed gas precipitate 1·43 grammes of metallic silver. (The results varied from 1·14 grammes to 1·80 grammes.) The proportion of absorbed gas being 1·42 to 3·52 per cent. of the volume employed. Regarding 1·43 grammes of silver as equivalent to 100 cubic centimètres,—that is to say, to 0·0088 grammes of ozonised hydrogen, 0·66 will be found the equivalent of ozonised hydrogen, or $\frac{2}{3}$rds of the equivalent of ordinary hydrogen.

These results led M. Osann to revert to an opinion he had abandoned after Mr. Andrews' experiments, and to admit that ozone and ordinary hydrogen have different equivalents.

M. Osann thought he could establish the equivalent of ozone by analysing the yellow body produced when ozonised oxygen is passed through a solution of oxide of lead in caustic soda, or when the same solution is decomposed by the electric pile. According to the author, this body is characterised as a combination of ozone by the property it has of turning blue the alcoholic tincture of guaiacum. The most simple hypothesis possible touching this body is, that it is composed of oxide of lead and ozone (Pb O, Oz).

There has been found in the yellow body obtained by ozonised oxygen,—

Lead, 89·52. Oxygen, 10·47.

Giving 4·27 as the equivalent of ozone. The yellow body obtained by the electric pile contained,—

Lead, 88·86. Oxygen, 11·14,

from which 5·16 may be deduced as the equivalent of ozone.

From these two experiments, the author concludes that the mean is 4·71, which he finds agrees very nearly with the results formerly obtained in his numerical determinations on ozonised hydrogen and ozone.

We have reported, with some detail, M. Osann's experiments, though it is impossible for us to admit his interpretation of them. His first analysis would lead to the formula Pb_2O_3, which requires Pb89·6, O10·4. It results from this, that the yellow substance analysed appears to be a kind of minium, having PbO_2, PbO for its formula.

Besides, it is evident that if ozone were an allotropic modification of oxygen, its atomic weight would be that of oxygen or of one of its multiples.

Analytical Notes.

Estimation of Nitric Acid.—Fresenius dissolved a known weight of fine piano-wire in an excess of muriatic acid, contained in a retort through which hydrogen passes; the nitrate is afterwards thrown in, and, after the dark colour has disappeared, the amount of protoxide in the cooled solution is determined by permanganate of potassa. The quantity of peroxide is now easily calculated, and from it the amount of nitric acid by which it had been peroxidised.—*Ann. d. Chem. und Pharm.*, xxx. 217—219.

Estimation of Silver in the Metallic State.—Fellenberg proposes to dissolve the chloride of silver in ammonia, dilute with water, precipitate by a strip of bright copper, collect and wash the silver upon a filter, incinerate and fuse with borax; or to incinerate the filter containing the chloride, without fusing the latter, and reduce it by means of pure lead upon bone ashes. These processes avoid the tedious drying of the filter and the precipitates.—*Schweiz. Zeitschrift*, v. 121—122.

Estimation of Arsenic.—A solution of pentasulphide of arsenic (AsS_5) in sulphide of ammonium yields instantly a precipitate of ammonio-arseniate of magnesia by a solution of magnesia. Lenssen states that the sulphides of tin and of antimony are not precipitated under the same conditions.—*Ann. d. Chem. und Ph. —Wittst. V. Schrift*, ix. 574.

Separation of Phosphoric Acid from Sesquioxide of Iron and Alumina.—W. Mayer states that the requisite proportions to effect this separation are, for 1000 cubic centimètres 15 grammes (1 equivalent) tartaric acid, 6 grammes (1 equivalent) anhydrous sulphate of magnesia, and 16·5 grammes (3 equivalents) of chloride of ammonium. With other proportions ammonia produces a precipitate containing besides ammonio-phosphate of magnesia, also basic tartrate of magnesia. —*Ann. d. Ch. und Pharm.* xxv.

Phospho-molybdate of Ammonia.—E. Spiess, of Munich, and Professor V. Eggertz, of Fahlun, corroborate Nuntzinger's analysis of this compound, who calculated, after drying at 212° F., the following formula:— $4(H_4NO, 10MoO_3) + (H_4NO + [8MoO_3, 2PO_5]) = 3{\cdot}577\ NH_4O, 3{\cdot}962PO_5, 92{\cdot}461MoO_3$.—*Wittst. V. Schrift*, ix. 527—429.

Anhydrous Oxalic Acid = C_2HO_4 is, according to Erdmann, obtained at ordinary temperature over sulphuric acid; it is proposed by him for preparing the normal acid of volumetric analysis.—*Journ. f. prakt. Chem.* lxxv. 4, 5.

Silicon in Iron.—The black residue left after dissolving crude iron in muriatic acid was found by Schafhäutl to evolve hydrogen from ammonia. Wöhler has proved it to contain oxide of silicon.—*Ann. d. Chem. und Ph.*, xxviii. 374.

Reaction of Strychnia.—The solid strychnia when mixed with solid iodic acid or iodate of potassa and a drop of strong sulphuric acid assumes, according to X. Landerer, on the application of a gentle heat, a beautiful violet colour, gradually changing to red-brown, remaining unchanged for many days. The thick liquid shows, after a few hours, a beautiful iridescence, continuing for several days.—*Hirzel's Zeitschrift*, xii. 86.

Protochloride of Iron is obtained pure, according to E. Amsler, by evaporating the recent solution almost to dryness, and adding powdered iron and strong muriatic acid in the proportion of one part of the former to five of the latter; the mixture is then evaporated to dryness with continued stirring by an iron spatula. The nascent hydrogen evolved will effectually reduce all the sesqui- to the protochloride and the dry salt will keep for a considerable time.

Tin in Vinegar.—Investigations caused by the State authorities in Potsdam have developed the fact that pure vinegar carried in bright tin measures from the cellar to the store contained a small quantity of tin, which increased on standing, and was considerable after boiling. Tin measures may probably be frequently the cause of

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the deleterious effects of vinegar, looked for in other circumstances.—*Arch. d. Med. Ges.*—*Arch. d. Pharm.*, cli. 115.

TECHNICAL CHEMISTRY.

Report on the Sanitary Condition of the City of London, for the Quarter ending June 22, 1861, with Table of the Composition of the River, and the Water from City Pumps, by H. Letheby, *M.B., M.A., Ph.D., Medical Officer of Health for the City of London, &c., &c.*

Meteorology and Condition of the River.—The mean temperature of the season has been about one degree below the average of former years (51·4°), and the thermometer has ranged from 82° to 36°. The daily range, however, has sometimes been as high as 24°. This, conjoined with the humidity of the atmosphere, which has averaged 85 per cent. of saturation, has been the cause of the large increase of lung diseases.

In the Spring Quarters of 1858 and 1859, when the river was so offensive, the average humidity of the air was only 68 and 69, and the mean temperature was 57·6° and 59·8°. During those quarters the warmth of the river, and the evaporation from its surface were considerable: indeed in the month of June of 1858 the temperature of the water was 72·4°, and in the corresponding month of 1859 it was 67·2°. In the succeeding months it rapidly rose to the temperature of 75°, and then the putrefaction of the water was at its highest; but during the quarter which has just expired, as well as that of 1860, the temperature of the river has not exceeded 62°, and there have been but slight signs of putrefaction. The conditions, therefore, which seem to be necessary for a high state of decomposition in the river are, a continued absence of rain, a hot spring, and a dry condition of the atmosphere. The temperature of the water must be over 60°, the rainfall less than 2 inches in the month, and the humidity of the air below 80°. With these conditions there is not only a diminished supply of fresh water from the upper tributaries of the river, but the volume of the stream is still further diminished by rapid evaporation from its surface. Under these circumstances the daily supply of sewage becomes concentrated, the downflow of the current arrested, and oceanic water rises in the bed of the river to maintain its tidal level. Then it is that the mixture of sewage and sea-water putrefies and becomes a nuisance. This state of things may be predicated not only by the temperature and dryness of the air, but also by the chemical composition of the water; for when the proportion of saline matter, at high tide at London Bridge, amounts to more than 60 grains per gallon, there is imminent danger of the river becoming offensive. This is the result of almost weekly observations made over a period of four years. As far as I know, there have not been any similar consecutive examinations made, and therefore they may be of service when the question arises as to the influence of the new system of drainage on the state of the river. Last year, and up to the present month of this year, the river has been in a normal condition; for its composition has not been very different from that recorded in the early analyses of Dr. Lambe and Dr. Bostock. In the course of the whole year, the proportion of saline matter dissolved in the river-water at high tide at London Bridge has amounted to only 28·9 grains per gallon, and the organic matter to 3·3 grains. The range has been from 19·6 to 57·3, and the organic matter from 2·6 to 5·5. The chief constituents of the saline matter have been as follows:—carbonate of lime 12 grains, sulphate of lime 4·5 grains, common salt 10 grains, alkaline nitrates about 2 grains, and ammonia in combination 1·3 grains. The quantity of suspended matter in the water has averaged only 6·4 grains to the gallon. At times it has risen to from 12 to 15 grains, but this has happened during high winds, as at the time of the equinoxes, when the surface of the water has been ruffled, and the mud upon the shore disturbed. The principal constituent of the suspended matter is ferruginous clay, and with this there is combined about one-fifth of its weight of organic impurity. It is remarkable that the river water near to the shore is always a little less impure than at mid-stream. This arises from the influx of fresh water, and perhaps also from the purifying influence of the atmosphere on the thinner stratum of liquid; as well as from the circumstance that the main current of the rising tide is in the middle of the stream.

The Water Supply and City Pumps.—In the course of the quarter, I have examined the water supplied to the City by the New River Company, and I have also analysed the water furnished by 22 of the City pumps. The first-mentioned supply has not been objectionable; for the quantity of saline matter dissolved in the water has amounted to only 17·4 grains per gallon, and the organic matter to less than 2 grains (1·9). The chief constituents have been as follows:—Carbonate of lime, 12·6 grains per gallon; sulphate of lime, 1·9; alkaline sulphate, 0·2; alkaline chloride, 1·2; alkaline nitrate, 1·0; silica and alumina, 0·5; and organic matter with traces of ammonia, 1·9. These results do not differ very materially from those obtained by Dr. Dundas Thomson, and reported in the Weekly Returns of the Registrar-General; and they show that the water is of good quality and is well suited for domestic purposes. Another advantageous property of the water is, that it is entirely without action on lead, and may, therefore, be stored in lead vessels, and distributed by lead pipes, without danger to the public health.

The quality of the water supplied by the City pumps is very different from that of the New River, for instead of an average of only 19 grains of solid matter per gallon, the water contains from 20 to 127 grains. Taking the pumps in the order of their foulness, they stand as follows:—Bishopsgate Street Without, 127·3 grains per gallon; Aldgate pump, 109·5; Cock and Hoop Yard, Houndsditch, 89·2; Bishopsgate Street Within, 89; Bride Lane, 84·7; Bow Church Yard, 84·5; Fenchurch Street, 83·1; Little Britain, 83; Basinghall Street, 81·6; Chequer Yard, Dowgate Hill, 81·1; Bell Yard, Gracechurch Street, 80; Idol Lane, 78·5; Ironmonger Lane, 76·2; Bartholomew Lane, 75·3; Cornhill, 74·8; Bowling Square, White Lion Street, 71; Half-moon Passage, 70·5: Great St. Helen's, 53·3: Gutter Lane, 45·7; Honey Lane Market, 44·2; Guildhall Buildings, 28; and Glovers' Hall Court, 19·8. The quantity of organic matter in them ranges from 1·5 grains per gallon to 8·8; the common salt from 2·7 to 25; the sulphate of lime, from 2 to 29; the alkaline nitrates, from 2·1 to 24·6; and the combined ammonia from 0·5 to 2 grains per gallon. These results show that the City pumps are not only charged with decaying organic matter, but also with the saline products of its oxidation; the ammonia, for instance, is a sign of present putrefaction, and the alkaline nitrates of a past; besides which, the existence of so large a quantity of common

salt is suggestive of the filthiest impurities, as, for example, the fluid matters discharged from the human body, and the percolations from cesspools and sewers. Most of these waters are bright and sparkling, and they have a cool and agreeable taste. They are, therefore, much sought after for drinking purposes; but the coolness of the beverage and the briskness of its appearance are dangerous fascinations, for they are both derived from organic decay Dead and decomposing matters have accumulated in the soil, and have been partially changed by its wonderful power of oxidation, and thus converted into carbonic acid and nitre. These have given to the water the agreeable qualities which are so deceptive. In reality, the water from the City pumps is far worse than that from the muddy river, from which it is in great part derived; indeed, it may, at any moment, become charged with the active agents of disease; for no one can say when the salutary influence of the soil may fail, by being worn out or over-taxed, and then the putrid organic compounds will pass into the wells unchanged. Many of the pumps are in close proximity to the fat graveyards of the City, and it is more than probable that all of them derive a portion of their water from these sources, for they are the principal gathering grounds for the surface springs; in fact, they are the only open spaces through which the rain can percolate to reach the shallow wells. Hereafter, when I have completed the inquiry into all the City pumps, I shall discuss this matter more fully; now, however, I merely direct attention to the general foulness of the water, and to the danger which may arise from the use of it. In the following Table I have shown the composition of those wells which have already been examined:—

Table of the Mean Composition of the New River Water as supplied to the City, during the Spring Quarter of 1861; of the Thames at High Tide; and of the Water from some of the City Pumps.

Source of the Water.	Constituents per Imperial Gallon.							
	Carbonate of Lime and Magnesia.	Sulphate of Lime.	Alkaline Sulphate.	Alkaline Chloride.	Alkaline Nitrate.	Silica, Alumina, &c.	Organic Matter.	Total.
	grs.	gr.	gr.	gr.	gr.	gr.	gr.	gr.
New River Company	12·6	1·9	0·2	1·2	1.0	0·5	1·9	19·3
Thames, High-tide at London Bridge	11·7	4·3	0·6	11·1	2·0	0·4	3·7	33·8
Pumps:								
Bishopsgate St. Without	34·5	27·4	7·9	24·6	24·6	1·9	6·4	127·3
Aldgate	26·2	25·8	..	25·0	24·3	1·1	7·1	109·5
Cock & Hoop Yard, Houndsditch	26·6	20·0	..	14·7	20·0	1·0	6·9	89·2
Bishopsgate Street Within	24·7	17·0	..	17·5	20·2	1·3	5·3	89·0
Bride Lane	11·5	21·5	..	22·5	19·5	0·9	8·8	84·7
Bow Churchyard	29·6	15·8	4·2	21·2	7·6	0·9	5·9	84·5
Fenchurch Street	21·0	18·3	..	14·2	22·4	0·6	6·6	83·1
Little Britain	27·9	10·2	15·2	13·8	5·8	1·9	8·2	83·0
Basinghall Street	23·4	29·0	3·0	12·6	7·8	0·9	4·9	81·6
Chequer Yard, Dowgate Hill	15·9	18·9	..	12·4	24·6	1·3	8·0	81·1
Bell Yard, Gracechurch St.	19·3	12·8	..	19·1	19·6	1·0	8·2	80·0
Idol Lane	16·8	16·6	..	16·3	22·4	1·8	4·6	78·5
Ironmonger Lane	19·8	16·3	5·2	10·6	7·0	1·6	5·7	76·2
Bartholomew Lane	23·3	14·3	0·4	16·7	15·1	0·9	4·6	75·3
Cornhill	25·0	15·7	1·1	14·0	12·9	1·6	4·5	74·8
Bowling Square, White Lion Street	18·0	25·2	5·0	8·2	7·8	1·1	5·7	71·0
Half-moon Passage	18·0	14·5	..	18·7	15·7	0·9	2·7	70·5
Great St. Helens	15·8	9·5	0·7	8·1	14·0	0·8	4·4	53·3
Gutter Lane	15·5	9·0	1·6	5·7	7·9	0·9	5·1	45·7
Honey Lane Market	15·1	6·1	3.7	11·4	4·4	1·4	2·1	44·2
Guildhall Buildings	13·4	1·9	3·0	5·3	2·1	0·3	2·0	28·0
Glovers' Hall Court	10·9	2·0	..	2·7	2·2	0·5	1·5	19·8

In every case the Water from the City Pumps was clear, and of a slight greenish tinge. It was exceedingly hard, and was without action on lead.

Sanitary Work.—The proceedings have had the effect of checking the supply of bad meat to the markets, for the total amount seized during the quarter is not half so much as that of the preceding quarter, and during the last month the quantity has fallen off very considerably.

Arrangements have been entered into with Mr. Ford, of Bell Isle, for the destruction of the meat thus seized; and to ensure its not being used as food, a chemical treatment is about to be adopted, before the meat leaves the custody of the Inspectors.

The last point to which I have to refer is the working of the Act for preventing the sale of adulterated food. Only six applications have been made to me during the quarter for the analysis of articles suspected to be adulterated; two of these were for beer, one for bread, one for milk, and one for cooked ham. Both of the samples of beer were of inferior quality, and one was adulterated with a sweet material, like liquorice; the bread also was of inferior flour, but the other things were sound.

On the Origin and Progress of the Phosphorus and Match Manufactures, by G. Gore.

(*Continued from page* 47.)

The following is the general process of manufacture of matches as now in use:—The wooden splints for the matches are prepared from the very best quality of pine planks, perfectly desiccated at a temperature of 400° Faht. Each plank is cut into about thirty blocks about eleven inches long, four and a-half inches wide, and three inches thick. A block is fixed with its small end downwards between two uprights, the grain of the wood being horizontal. A frame, having fixed upon its upper surface about thirty lancets one-eighth of an inch asunder, with their points projecting upwards one-eighth of an inch, reciprocates to and fro beneath the end of the block of wood by means of a crank, and in doing so scores the whole of the lower surface of the block with a number of parallel cuts, about one-eighth of an inch apart and one-eighth of an inch deep, in the direction of its fibres. Immediately upon this a sharp blade, or scythe, swings round horizontally beneath, and cuts off the scored surface to the thickness of one-eighth of an inch, in the form of square splints four and a-half inches long, which fall through a shoot into a room beneath. The block now sinks one-eighth of an inch and the operation is repeated. In this way between two and three millions of splints are readily formed by steam power in a single day. English splints are of two sizes—large and minikins: the larger ones are two and a-quarter inches long (or double-length, as first formed, *i.e.* four and a-half inches), and the minikins are rather shorter.

In England the splints are square in form, and produced as above; but in Germany they are cylindrical, and are prepared in this shape by placing the small block of wood with the ends of its fibres downwards upon a strong plate of steel of larger surface, perforated over the greater part of its surface with holes of the size of the splint, countersunk at their entrances to form cutting edges, and as close together as possible. Great pressure being now applied to the upper end of the block, it is forced through all the holes, and reappears on the lower side of the steel plate in the form of a heap of cylindrical splints.

Returning to the English splints—they are collected

as they are cut, and measured into bundles of six dozen each by a man who seizes a number of them in his hands from the loose and irregular heap, and by dexterous jerking, knocking, and shaking, arranges them parallel to each other, then places them in a short open gutter or cradle, across which he has previously thrown a piece of string, and when the measure is full to the level of its edges he ties up the bundle, throws it aside, and proceeds with another with equal rapidity. The bundles are then perfectly dried by exposure for several hours in a heated oven.

The bundles of splints are next coated at both ends with sulphur. A quantity of brimstone is melted in an iron pot, and one end of a bundle being quite scorched by contact with a red-hot plate is immersed into the melted sulphur to the requisite depth; then repeatedly swung in the air, to throw off the superfluous sulphur, and rolled violently upon its axis and beaten, to prevent the splints adhering together in one mass as the sulphur hardens. The other end is then similarly treated. In some cases the ends of the splints are saturated with wax instead of sulphur in a similar manner.

A child now arranges the splints in a number of successive rows, one above another, in a frame, each splint separate from the others, in the following manner:—He takes a narrow wooden frame composed of three fixed pieces, a narrow bottom cross-piece about sixteen inches long and two inches wide, with two vertical pegs about eight inches high, one at each end; and has by his side about two dozen loose strips of wood of similar length and width to the bottom piece, and with holes or notches at their ends to receive the upright pegs; each of these strips has a series of fifty transverse shallow notches upon its upper surface to receive fifty splints, and is covered on its lower side with felt or other soft material. Having placed one of these strips upon the bottom piece, he takes up a handful of splints and quickly deposits fifty of them, one in each groove, their ends projecting one and a-quarter inches on each side; he then places another strip upon the first one, and fills it in like manner, and so on until the pile of twenty-four rows is complete. A thicker strip of wood, similar to the bottom piece, covered upon its lower side with felt, is then placed upon the top, and the whole secured moderately tight by means of thumb-screws, or pegs fitting into holes in the uprights. The splints are then ready for being tipped at their ends with the phosphorus composition. Many children are employed at this kind of labour.

The exact ingredients, and their proportions, in the phosphorus composition, differ in different countries and with different manufacturers, but they all consist essentially of emulsions or mixtures of phosphorus in a solution of glue or gum arabic, with or without other matters for increasing the combustibility, for colouring, &c. In England the composition contains a considerable quantity of chlorate of potash, which imparts a snapping quality, and noisy projecting flames, and but little phosphorus, on account of the moisture of the climate; other substances are also added to give hardness and power of resisting moisture. The following is about the composition of the best quality:—

Water . . .	4	parts by weight.
Glue . . .	2	„ „
Phosphorus . .	1½ to 2	„ „
Chlorate of potash .	4 to 5	„ „
Powdered glass .	3 to 4	„ „

In Germany the proportion of phosphorus used is much larger, and gum is used instead of glue, together with nitrate or peroxide of lead, and no chlorate of potash. In consequence of the presence of so much phosphorus and the absence of chlorate of potash, the German matches light quietly, with a mild, lambent flame, and are injured quickly in a damp place by the oxidation of the phosphorus and the production of phosphoric acid, which attracts moisture. One of their mixtures, given by Böttger, is composed as follows:—

Phosphorus . .	4	parts by weight.
Nitrate of potash .	10	„ „
Fine glue . .	6	„ „
Red ochre . .	5	„ „
Smalt . . .	2	„ „

In every case the glue is first broken into small pieces and soaked in cold water until quite soft, then added to the requisite quantity of water and heat applied by means of a water-bath until it is quite fluid, and at a temperature of 200° to 212° F. The vessel is then removed from the fire, the phosphorus gradually added, and the mixture agitated briskly and continually with a stirrer, having wooden pegs or bristles projecting at its lower end. The chlorate of potash, colouring, and other matters, all in a state of very fine powder, are then added, one at a time, to prevent risk of accident, and the stirring continued until the mixture is comparatively cool. By this means the minute particles of phosphorus are kept from uniting into large globules, and the heavier matters are prevented from sinking to the bottom.

In the process of tipping the ends of the matches (termed in the manufactory "dipping"), a quantity of the composition is spread, by means of a large palette-knife, upon the horizontal surface of a smooth stone or plate of iron, heated by means of steam beneath. The mixture becomes much more fluid by the heat, and is spread to a width and length of about ten inches by twenty, and a uniform depth of about one-eighth of an inch by means of a horizontal gauge. The "dipper" then takes a frame filled with splints, as already described, strikes the ends of the splints upon a bare part of the stone until the whole of those ends exhibit a flat, uniform surface. He then dips those ends, either once, twice, or more times, into the mixture, until they have all received a proper amount, and hands the frame to a boy, who places it upon a rack in a current of air, in order that the composition may cool and harden. Meanwhile the dipper proceeds with other frames in like manner, and replenishes the layer of composition occasionally. After a number of frames have been thus dipped, and the composition upon the splints in them has partly hardened, they are all taken, one by one, in the original order, and the other ends of the splints tipped in a similar manner. With six dipping-stones, half-a-dozen workmen have dipped as many as twenty millions of matches in a single day. This method of dipping is termed "frame-dip"; but there is another process called "bundle-dip." which consists in taking a bundle of the sulphured splints, twisting it in such a manner that the ends of the splints spread out like a brush and separate from each other; they are then tipped with composition like the others. In this process the *ends* only of the splints acquire a coating of the mixture, whereas in frame dipping the composition extends a short distance up the *sides* of the splints and is more firmly attached. Bundle-dipped matches are inferior to frame-dipped ones.

In the manufacture as now being described it will be observed that each splint is 4½ inches long, coated with composition at both ends, and will therefore form two

matches by being cut asunder in the middle; but this is not always the mode of proceeding; in some manufactories the splints are cut in two before being dipped, and are tipped at one end only.

As soon as the composition is partly dry, and of such a degree of hardness as to bear the next operation without igniting and without rubbing off, the splints (those coated at both ends) are quickly removed from the frames into parallel heaps, and the frames set at liberty. A man now takes a heap of fifty of the splints, places them between two vertical supports in a horizontal channel or trough of wood, passes a string with a weight over them to prevent their falling about, and cuts them through at their middle by means of a cork-cutter's knife, moving upon a hinge like a chaff-cutter's scythe. He then places them in heaps of 100 matches each, ready for boxing. The little boxes are now filled by women and children, who perform the operation with exceeding rapidity, and before the matches are dry, in order to avoid accidents. Each match passes through the hands of about seventeen persons, chiefly children, in its process of manufacture.

Trays of sawdust are placed near the various workmen and operators to plunge the matches into in case they ignite. Vessels of water are also freely at hand in case of accident. Also a quantity of sand is strewed in a layer of several inches deep beneath the racks upon which the frames of matches are set to harden, so that in case of a frame of matches falling, the flames may be quickly extinguished. A lotion, composed of olive oil and lime water, is exceedingly useful to apply to the skin in cases of burning by phosphorus.

(To be continued.)

Working in Aluminum.

We extract the following valuable article from the *Ironmonger*. The information is obtained from Messrs. Bell and Brothers, Newcastle-on-Tyne, manufacturers of aluminum.

The peculiar properties of this substance having been so little understood, has hitherto hindered its general employment, but now that it is sold in a pure state at as low a rate as 50s. per pound avoirdupois, it is likely to be much more frequently used.

Aluminum is a metal of fine white colour, slightly inclining to blue, especially after being well hammered when cold.

Aluminum, like silver, is susceptible of a very fine "matting," which is not affected by exposure to the air, or by any of the impurities usually present in the atmosphere of towns. To obtain this matting, the aluminum objects (being previously washed in benzole or essence of turpentine) must be plunged into a weak solution of caustic soda, thoroughly well washed, and exposed to the action of strong nitric acid. When the desired matting has been obtained, it must be well washed again, and dried in sawdust.

Aluminum is easily polished or burnished. To do this, it is necessary to use a mixture of equal parts of rum and olive oil, as an intermediate substance between it and the polishing stone or powder used. The polishing stone is steeped in this mixture, and will then burnish aluminum in the same manner as gold and silver is burnished, care being taken not to press too heavily upon the burnishing instrument.

Aluminum can be beaten out, either hot or cold, to the same extent and as perfectly as gold or silver; and it is susceptible of being rolled in much the same way as either of the above metals. Leaves as thin as those used for gilding and silvering can be made of aluminum. Covered ingot moulds of iron answer best for receiving aluminum intended to be used in the rolling mill. Aluminum quickly loses its temper, and therefore requires frequent reheating. The temperature of this reheating is a dull red heat, and when the plates become very thin, this demands the greatest attention.

Aluminum is easily drawn into wire. For this, the ingots are run into an open mould, so as to form a kind of quadrangular shape of a little less than half-an-inch section, which is then beaten upon the edges by the hammer very regularly; the operation of drawing out is then commenced on a horizontal bench, by very gradually reducing the diameter of the metal intended to be drawn into wire, and by frequent reheating, and then the ordinary process of wire-drawing can be proceeded with. When the threads are required extremely fine—as, for example, for the manufacture of lace—the heating becomes a very delicate operation, on account of the fineness of the threads and the fusibility of the metal. The heat of the current of air issuing from the top of the glass chimney of an Argand lamp will suffice for the heating.

The elasticity of aluminum is very much the same as that of silver, and its tenacity also about the same. The moment after it has been melted aluminum possesses about the hardness of pure silver; when it is hammered out, it almost resembles that of soft iron; it becomes elastic, acquiring, at the same time, considerable rigidity, and emits the sound of steel when suffered to fall on a hard body.

A property which aluminum manifests in a high degree is that of excessive sonorousness. This property has already rendered it of service in the construction of several musical instruments.

Aluminum is much lighter than ordinary metals. Its density is 2·56, a quarter that of silver, and about a third that of iron. By the action of the hammer. the density of aluminum increases sensibly, so as to become equal to 2·67.

Aluminum melts at a higher temperature than zinc, and a lower one than silver; to melt it, an ordinary earthenware crucible must be employed, without the addition of any sort of flux.

Its low point of fusion, along with its slowness of heating, require that for melting it a less intense fire should be used, but applied for a longer time than in melting silver.

It is easily melted in an open crucible, which facilitates the removal of the dust and other impurities which appear on the surface of the metal; and for the purpose of stirring the entire mass, a clean iron spatula is used.

Aluminum is easily run into metallic moulds; and, still better, for objects of a complicated form, into moulds of dry porous sand, formed so as to allow an easy passage for the air expelled by the metal, which is viscous when melted. It ought to contain a greater number of passage holes, and should be so managed as to run it in one long and perfectly cylindrical git. When heated to a red heat, it ought to be poured out with tolerable rapidity. A small portion of the fused metal should be caused to run into the git itself when full, to compensate for the contraction of the substance of the metal at the moment of solidification.

By following all these precautions, castings of the highest degree of fineness may be obtained; but, at the

same time, to succeed perfectly, an especial acquaintance with the subject is needed.

In the production of work where the use of the lathe becomes necessary, any scratching or tearing of the metal by the tool is avoided by covering the surface to which the tool is applied with a varnish composed of stearic acid and essence of turpentine.

When aluminum is soiled by greasy matters, it can be cleaned by benzole; if it be soiled by dust only, india-rubber, or very weak soap and water may be used.

The pieces of aluminum intended to be soldered must be prepared in the same manner as objects are treated for soldering with tin, viz., by a "tinning;" but it must be remembered that it is indispensable that this tinning must take place with the solder itself. The pieces to be soldered, thus tinned beforehand, are afterwards joined together, and exposed to the flame either of a gas blowpipe, or any of the ordinary sources of heat used in such cases. In order to unite the solderings, small tools of aluminum are used. These tools are used as little soldering instruments, and they facilitate at the same time the fusion of the solder, and its adhesion to the previously prepared aluminum.

The use of tools of copper or brass used when soldering gold and silver, must be strictly avoided, as they would form coloured alloys with the aluminum and the solder. It is of the greatest importance never to use any flux to cause the solder to melt, as all those at present known attack aluminum, and prevent the adhesion of the pieces to be soldered. The use of the little tools of aluminum is an art which the workmen must acquire by practice; in fact, at the moment of fusion the solderings must have the friction applied, as they melt suddenly in a complete manner. In soldering aluminum, it is well to have both hands free, and to use only the foot for the blowing apparatus.

Solders of different compositions and degrees of fusibility have been employed in soldering aluminum. The following are those which have been generally used, ranged according to their order of fusibility:—

	I.	II.	III.	IV.	V.
Zinc . . .	80	85	88	90	94
Copper . . .	8	6	5	4	2
Aluminum .	12	9	7	6	4

No. 4 is the one usually preferred, particularly for soldering smaller objects.

In order to make the solder, the copper is first melted, the necessary aluminum is added, and stirred by means of an iron spatula, unpolished, as it comes from the blacksmith, adding also a little tallow; the zinc is then added, avoiding too much heat, as this last metal is easily oxidized, and is very volatile.

NOTICES OF BOOKS.

Water: its Impurities and Purification. By F. Hahn Danchell. London: H. Renshaw, 356, Strand, W.C.

Under the above title a little work has been published which will be found of considerable use to those of our readers who, without going to the expense or trouble of obtaining a complete qualitative or quantitative analysis of a water, may still desire to know by a few simple tests what injurious substances are likely to be present, and how they are to be got rid of. The work is intended to accompany a simple water-testing apparatus, which consists of a selection of tubes and bottles of various appropriate tests of definite strength, so that by adding to successive tubes full of water a certain number of drops of each test in rotation, the presence or absence of ammonia, decomposed organic matter, lead, carbonate of lime, sulphate of lime, sulphuric acid, and iron, may be ascertained. The author states in his preface:—"To the head of every family it presents a ready means of ascertaining the purity of that substance which is the most extensively used, and the most absolutely essential of all those required for the support of our existence; to the keeper of horses and cattle it will, I believe, point out many of the hitherto concealed sources of the mysterious epidemics and diseases from which such severe losses have arisen; the agriculturist, by its means, will be enabled to determine the probable advantages to be derived from the use of any particular water for irrigation; the manufacturer may ascertain the nature and suitableness of the water supplied for his use; whilst to emigrants, about to choose their future home, it will have an especial value, as indicating the localities which, if health be valued, are to be chosen or avoided. And although my little apparatus has no pretensions to supply the place of, or dispense with the necessity for, an accurate qualitative and quantitative chemical analysis, I yet venture to think it will be found of use by medical and scientific men, who may have occasion to ascertain, in a ready way, whether any of the more usual impurities are present or not in water. The tests being all made dependent upon colour, and the mode of operating being merely the addition of a few drops of the test fluids to water, no chemical knowledge is required for their application. The tests are all sufficiently delicate and accurate for practical purposes, and the apparatus is extremely portable, and conveniently arranged. I have by means of these tests placed it in the power of the public to ascertain for themselves whether the representations made by myself and other filter makers are well founded or not. By means of these tests, not only can the condition of the natural water be ascertained, but the state of purity in which it is left after passing through the filtering medium may be ascertained with just as great certainty and ease."

The importance of a plentiful supply of pure water cannot be overrated. For domestic purposes, such as cooking and washing, and for manufacturing purposes, such as distilling, brewing, tanning, dyeing, starch making, paper making, and chemical works, the main use of water is as a solvent. Anything, therefore, which detracts from its solvent powers, must more or less unfit it for the purposes above referred to. It is well known that hard water requires more soap to wash with—that it necessitates the use of more tea and coffee to make our every-day beverages—more meat to produce soups and gravies—more malt to give us spirits and beer—more bark for tanning extract—and more chemicals for producing the various extracts—than would be required were perfectly pure, or at least soft water, used. The actual loss from these sources must be something enormous, amounting to many million pounds sterling per annum.

For many manufacturing purposes, such as bleaching, paper making, &c., it is also necessary that the water used should be perfectly free from colour; consequently, where traces of iron or decomposed organic matter are present, they must either be removed or some other source of supply sought out. Great expense is often gone to in sinking Artesian wells, or conveying pure water from a long distance, where no real necessity for such outlay exists. And for the domestic and manufacturing purposes enumerated, it may safely be affirmed, that no natural water is so pure as not to be capable of great improvement by a judicious system of filtration and purification.

After some clear remarks upon the different kinds of impurities present in water and the various means adopted for their separation, the author continues:—

"A water purifying apparatus, then, should be able to act upon the impurities held in solution as well as those

in mechanical suspension. It should be composed of materials incapable of giving any taint to the water passing through it. Its action should be rapid and effective. Its operation attended with the least possible trouble, or necessity for attention on the part of servants. It should be capable of retaining its purifying properties for a lengthened period. It should be so arranged that the filtering medium may be easily got at for cleansing or renewal. And, finally, the price should be such as to place it within the reach of all classes in the community."

It is scarcely necessary for us to state that this is followed by an assurance that the filters made according to Mr. Danchell's plan more than fulfil all the above conditions. Whether this be the case or not, we have had no opportunity of judging, but it is only fair to say that the material upon which he mainly relies as a purifying agent is about the best that could be employed, and that the style in which the little work is written shows that the author thoroughly understands the subject of water purification.

NOTICES OF PATENTS.

Manufacture of Gas. John Leslie. (Two Patents.)

These two patents are of great commercial importance. The first patent has for its object improvements in the manufacture of gas. Heretofore in manufacturing gas from coal and other bituminous mineral substances it has been usual to subject them to the process of destructive distillation, and then to purify the gas obtained. These improvements in the manufacture of gas for the purposes of illumination from Parrot coal, Cannel coal, Boghead coal, and other mineral bituminous matters capable of affording paraffine, consist in subjecting such mineral bituminous matters to distillation at low temperatures, in order to obtain the products distilled over in a condensed liquid form, and then to subject such liquids to processes of purification, in order to fix or remove the ammonia, sulphur, and other impurities, and then to subject the purified liquids to destructive distillation, by which very pure gas is obtained.

In the manufacture of gas from coal by destructive distillation as at present practised in gas works, it is necessary to employ very extensive, and at the same time, very expensive machinery and processes between the retorts where the gas is distilled off and the gasometers wherein the gas is stored for distribution, and the necessity for the use of such machinery and processes arises from the high temperatures employed in distilling over every vaporizable constituent of the coals employed, by which not only is the illuminating gas distilled off, but also very inferior and deteriorating gases, with products of sulphur and other impure matters, which are prejudicial not only in respect to the illuminating powers of the combined gases, but they are also injurious in other respects. And it is for the purposes of purifying the gases from the sulphur and other impure products that gas works have heretofore found it necessary to employ such extensive and expensive machinery and processes. In addition to the above objections, large quantities of tar, as well as of very offensive products, result from the present system of manufacturing gas from coal at gas works, resulting in a great waste in regard to the quantity of good and pure illuminating gas a given weight of coal is capable of affording. According to this invention illuminating gas may be manufactured from coal and other bituminous mineral in such manner as to dispense with the use of the machinery and processes now necessary in gas works for purifying the gases after they leave the retorts, and before they arrive at the gasometers. It consists in so arranging gas works as to employ in the manufacture of gas the hydrocarbon products of coal or other bituminous minerals obtained by distilling such substances at a low temperature, whereby the patentee is enabled to dispense with the machinery and processes used for purifying illuminating gas obtained by the existing process of destructive distillation of the bituminous mineral; for these purposes Cannel coal, parrot coal, Boghead coal, and other coal, and other mineral bituminous matters, are distilled at a low temperature, in such manner as to obtain the products in a condensed form in place of in the state of gases; then, when necessary, the resulting fluids are purified, and then such fluids are subjected to the action of heat in a finely divided state in retorts or vessels, to convert them into gas, which is conveyed into gasometers such as heretofore used at gas works, in order that the same may be distributed therefrom, as heretofore practised.

Mr. Leslie prefers to use a cylindrical retort heated externally by a fire, such retort being caused constantly to revolve slowly. Into this the coal or bituminous mineral is introduced, broken up into small pieces, and the products evolved pass off to the condensing apparatus, which is constantly kept cool by water, and the condensed hydrocarbon products are received into a suitable receiver or vessel. Care is to be taken to keep down the heat of the retort, in order to prevent the production of gas or vapours which will not condense, the object being to obtain only fluid hydrocarbons by the first process of distillation.

When using the better classes of Cannel coal, the hydrocarbons obtained may at once be employed for the manufacture of gas, but when using hydrocarbons (obtained from less pure coal or other bituminous mineral) which have nitrogenous and sulphur compounds combined therewith, these are purified in the following manner:—To remove the nitrogen the crude hydrocarbons are washed with dilute acid; dilute sulphuric acid will answer the purpose, but dilute muriatic acid is preferable prepared by adding five gallons of water to one gallon of the concentrated muriatic acid of commerce; the hydrocarbons are then agitated violently with this diluted acid, using 15 gallons of the diluted acid to every ton of the oil. The mixed hydrocarbons and acid is then allowed to stand for twelve hours, at a temperature of 90° to 100° Fahrenheit, and then the layer of acid liquor which will have separated must be drawn off. To free the hydrocarbons from sulphur compounds, the patentee uses at the rate of 1 lb. caustic soda with 1 gallon of water, and from 14 to 30 gallons of such solution will be found sufficient to purify a ton of the hydrocarbon fluid; for this purpose the solution is well stirred into the hydrocarbons, and then allowed to settle for some hours, when the purified hydrocarbons may be readily drawn off from the impurities.

In order to convert the hydrocarbon liquid into illuminating gas, it is caused to drop into a retort or vessel heated to a good red heat, and the gas is conveyed from the retort into gasometers of the ordinary construction, from which the illuminating gas is supplied to the gas mains, as gas has heretofore been supplied from gasometers.

By these improvements not only will gas works be rendered less objectionable in any neighbourhood, but the gas obtained will be more pure, and the cost of production will be greatly reduced.

The second patent has principally for its object the purification of gas after it is manufactured. For these purposes, in distilling coal or other substance, the gas, in place of being conducted off from the upper part of the retort, and thence into the hydraulic main, is caused to descend from the retort at the lower part thereof into a chamber, and thence the gas is conducted off by a pipe at the upper part of the chamber to purifiers. Several

retorts may be connected with the same chamber, in which case they each have a slide or other valve to shut the entrance into the chamber. And in purifying gas, a solution of a salt of copper, preferring the sulphate, is employed to saturate wood shavings or other porous material, through and amongst which the gas is caused to pass. The purifying matters thus employed are from time to time subjected to the passage of atmospheric air amongst them to re-prepare them for the further purification of gas therewith.

By the kindness of the Patentee we have been enabled to witness some of the remarkable results which are obtained by these processes. A weighed quantity (2½ lbs.) of Boghead coal was placed in a retort, which was kept slowly revolving over a fire, the temperature never approaching a red heat, and, indeed, scarcely reaching that of melting lead. The slow rotation of the retort preventing any one portion of the coal from becoming hotter than the rest, the volatile constituents were all evolved in the liquid form, no gas whatever being produced. In a short time the 2½ lbs. of coal had yielded in the receiver 1½ pints of hydrocarbon fluid, leaving ¾ lb. of coke in the retort. As soon as the liquid had ceased to come over, it was carried to an iron retort which was kept at a red heat by means of a furnace, the arrangement being similar to that employed in gas-works. The 1½ pints of hydrocarbon fluid was then allowed to drop through a funnel tube into this red-hot retort, when the gas-holder which was in connexion with it instantly began to rise, and within a minute and a-half 25 cubic feet of gas had come into the holder. The next day the luminosity of the gas, which we had seen prepared, was ascertained by means of a photometer. When burning at the rate of *four feet* per hour, it equalled twenty sperm candles.

The remarkable character of these results becomes more apparent if we calculate by the ton instead of the pound. A yield of 1½ pints for every 2½ lbs. of coal is equivalent to 168 gallons per ton of 2240 lbs. Now 168 gallons is almost exactly one cubic yard, and calculating each gallon to produce, almost instantaneously, 128 cubic feet of gas, we have thus 21,504 cubic feet of gas from 168 gallons, the material for the production of which only occupying one cubic yard of space.

Besides the greatly-increased yield obtained by this process, there are other advantages which recommend it to the serious consideration of Gas Companies. By its means all the refuse coal which is now completely wasted at the pit's mouth may be distilled into oil at the collieries. This fluid may be further purified from sulphur and other deleterious substances on the spot where it is made, whence it could be carried up to London, and converted into gas in the space of a few minutes. The advantages of this would be: the coal being used at the pit's mouth would cost a mere trifle; all the troublesome work of distillation and purification, with its concomitant evils of poisoning the neighbourhood by the offensive odour, could be performed where labour was cheap, and ground plentiful, instead of as at present in the heart of London; the expense of carriage of material to London would be considerably reduced, as only the real gas-making constituent of the coal would be transported; and lastly the complicated machinery of plant and hands, with the sickening odour with which it is always surrounded, would be in great measure done away with, no purifying apparatus being needed, and the mechanical labour of converting any quantity of the hydrocarbon fluid into gas, being reduced to the capacity of "a man and a boy."

Pigments for Coating Surfaces. G. Hallett and J. Stenhouse.

This invention consists in the employment of the oxides of antimony, either native or artificially prepared, as pigments suitable for out-door application, and to be used in much the same manner as white lead. For the preparation of their material the patentees employ at once the native oxide, or that kind of mineral in which a certain quantity of the sulphide of antimony is associated with the oxide. These are crushed to a tolerably fine powder, and purified from the gangue or matrix by mechanical sorting and washing. The heavy ore is dried and subjected to the process of calcination or roasting in a reverberatory furnace with a plentiful supply of air, during which treatment all the sulphur is expelled, and the residual metal converted for the most part into antimonious acid. The calcined product requires to be very finely ground, and mixed with any suitable oil or varnish to form the paint.

In the preparation of antimonial oxides from ores or metallic regulus there is a tendency for the product to become slightly discoloured by the presence, in small quantities, of other metallic oxides (*e.g.*, those of lead, copper, and iron), traces of either of which common impurities operate powerfully in darkening the shade of colour possessed by the pure oxide of antimony. On this account the antimony paint would not be so suitable as zinc or white lead for application whenever purity of tint is desired; but would, nevertheless, seem well adapted for the preparation of stone colour. In all cases where the painted surface would afterwards be liable to the action of an atmosphere impregnated with sulphuretted hydrogen the antimonial stone colour would, in comparison with lead, have the advantage. Although possessing more body than zinc paint, it does not appear to be, in this respect, equal to white lead.

An Impermeable Protective Coating for Leather. C. Stevens. A Communication. (Not proceeded with.)

This proposition relates to the employment of gutta-percha and india-rubber, severally dissolved in bisulphide of carbon, for the purpose of coating leather, and thereby rendering it less liable to become deteriorated by the action of the acids usually present in common blacking. Saturated solutions are preferred; that containing india-rubber is recommended to be first applied.

The advantage of employing the bisulphide of carbon in preference to other cheaper and more agreeable solvents for making the varnishes is not very manifest, unless on the assumption that the agent described in the specification must appear to possess the charm of novelty.

CORRESPONDENCE.

Bisulphide of Carbon in Gas.

To the Editor of the Chemical News.

Sir,—My Report on "Bisulphide of Carbon in Gas" has been honoured with such marked notice in the last two numbers of your Journal, that I am obliged to request the favour of the insertion of this letter.

Any writer of an ordinary pamphlet must expect to have his composition criticised, and must submit to be abused or complimented, as the case may be. I therefore ought to be highly flattered on seeing that so much notice has been taken of the Report in question; and I could well afford to let your articles pass unnoticed if my silence would not be taken as a confirmation of the statements made in your pages, and if the articles had been merely simple criticisms. But when I find that experiments have been made, the result of which have been placed in juxtaposition to mine, evidently for the sole purpose of confuting them, I feel justified, before entering into the merits or demerits of either, to ask through you the name of the author of the articles.

I shall be very pleased to accept the challenge implied, but before doing so certainly may expect in fairness my request acceded to, especially as my experiments were vouched for by the attachment of my signature.

I therefore again request to know who is the "we" who has made the "independent examination" from which such wonderful numbers have been deduced, and who seems to possess the peculiar facility of casting insinuations repugnant to the minds of scientific and honourable men. I am, &c.

Fred. Versmann, F.C.S.

Chemical Laboratory, 7, Bury Court, St. Mary Axe, July, 1861.

[The Editor's name is printed on each number of the Chemical News, and he takes the responsibility of all Editorial articles. We cannot see that Mr. Versmann has anything to complain of. Far from wishing to cast insinuations to which he, as a scientific and honourable man, could object, we took particular pains in each notice to assure our readers that we did not intend to question the perfect accuracy of Mr. Versmann's results.—Ed. C. N.]

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Explosion in Making Phosphoric Acid.—Elsner relates (*Chem. tech. Mittheilungen*, 1859-60, s. 121) that some time since as a chemist was making phosphoric acid, by acting on phosphorus with nitric acid in a retort, a tremendous explosion took place when the mixture was heated, which not only shattered the retort but blew out all the windows, and even shook the walls of the laboratory. The cause of the explosion he supposes to be the formation of phosphuretted hydrogen from the sudden decomposition of vapour of phosphorous acid into that gas and phosphoric acid. Elsner recommends that the phosphorus should be treated with nitric acid in a large dish, so that the vapour of phosphorus acid may have free escape.

Behaviour of Sulphurous to Iodic Acid.—Dr. H. Kaemmerer describes (*Journal für prakt. Chemie*, Bd. lxxxiii. s. 72) an hitherto unobserved reaction of sulphurous on iodic acid. He took finely-powdered anhydrous iodic acid and acted on it for some time by dry sulphurous acid. When the action had continued a quarter or half-an-hour, decomposition commenced, and a small quantity of iodine was set free, which escaped from the exit tube with the sulphurous acid. Immediately afterwards the remaining iodic acid suddenly became of a bright yellow colour, having formed, says the author, the compound $5IO_5 + SO_3$. This body must be quickly placed in a perfectly dry bottle, as it soon decomposes in the air.

If the action of the SO_2 be continued longer, rapid decomposition ensues, much iodine separates, and the mass collects together in small lumps, which adhere to the tube. From these free iodine and sulphuric acid may be washed out by alcohol and water, and then there will be left a new compound of iodine and oxygen I_3O_{13}, with a small per-centage of SO_3, which it is difficult to remove.

The *sulpho-iodic acid anhydride* $5\ IO_5 + SO_3$ has a beautiful bright yellow colour, a granular appearance, and the remarkable property of decomposing in contact with water, iodine being separated. In absolute alcohol and in ether it simply splits into IO_5 and SO_3, forming in an alcoholic solution of potash iodate and sulphate of potash.

The new compound I_3O_{13} is a brown yellow powder, which does not change in the air, but always takes up some water. It dissolves in dilute nitric acid with the separation of iodine; fuming nitric acid oxidises it to IO_5; water at the ordinary temperature decomposes it slowly; boiling water splits it up immediately into I and IO_5. Heated alone to 100° it breaks up in the same way: $5\ I_3O_{13} = 13\ IO_5 + 2\ I$.

Aqueous solutions of the alkalies decompose the new compound, forming iodates of the alkalies and setting free iodine. Alcoholic solutions have no action on the compound, nor have absolute alcohol, ether, acetic ether, or sulphide of carbon, either at the ordinary temperature or at their boiling points.

New Oxychloride of Bismuth.—M. Lebaigue has obtained a compound to which he attributes the formula (Bi_2Cl_3, 2 Bi_2O_3) (*Journal de Pharm. et de Chim.*, Tome xxxix., p. 108). He treated oxide of bismuth with sulphuric acid, heated the mass until no more acid vapour was given off, mixed the yellowish powder obtained with twice its weight of fused chloride of sodium, and placed the mixture in a clay retort set in a reverberatory furnace. After keeping the retort red hot for some time, he was surprised to find that nothing distilled. He then allowed it to cool, broke the retort, and found a fused mass, which treated with water broke up into the soluble acid chloride and insoluble sub-chloride. Mixed with the latter were some brilliant white scales, which the author carefully separated and analysed. The results led the author to believe that the scales were formed of new oxychloride of bismuth, having the formula (Bi_2Cl_3, 2 Bi_2O_3).

II. ORGANIC CHEMISTRY.

New Acid from Toluol.—Fittig gives (*Annal. der Chem. und Pharm.*, Bd. cxvii. s. 191) a preliminary notice of a new acid he has discovered in the oxidation of tuluol by nitric acid. It is colourless, perfectly insoluble in cold water, and only slightly soluble in hot water. At a higher temperature it fuses and sublimes undecomposed. It appears to have the same composition as salicylic acid without being identical, for it does not give the reaction of salicylic acid with chloride of iron. The baryta salt is easily soluble in water, and crystallises from the solution in warty tufts. The analysis of the crystals gave 32·7 per cent. Ba. The formula $C_{14}H_5BaO_6$ requires 33·3 per cent. Ba.

III. ANALYTICAL CHEMISTRY.

New Test for Sulphurous Acid.—A solution o nitroprusside of sodium, added to a solution of sulphite of soda, gives a pale rose colour, which is much more distinct when an excess of sulphate of zinc has previously been added to the solution of nitroprusside; but an intense purple red is produced when a small quantity of yellow prussiate of potash is added to the mixture. This reaction may be applied to the detection of sulphurous acid in the following way:—If the substance to be tested is soluble in water, but not neutral, it is first neutralized with acetic acid or bicarbonate of soda; an excess of the latter is not objectionable, but an excess of either caustic or carbonate of soda, or of carbonate of ammonia, prevents the reaction. If any bases are present which give insoluble salts with sulphurous acid, these must be removed. Then a proportionately large quantity of solution of sulphate of zinc is mixed with a very small quantity of nitroprusside of sodium, and added to the solution to be tested. When the amount of sulphurous acid present is not too small, a rose red or dark red colour is soon produced; but if it is not very distinct, the addition of some yellow prussiate will give an intense red. In this way a most minute quantity of sulphurous acid may be detected. Hyposulphurous acid, and hyposulphites of the alkalies, under the same circumstances, produce no reaction.—*C. Boedeker. Annal. der Chem. und Pharm.* Bd. cxvii. s. 193.

IV. TECHNICAL CHEMISTRY.

Adulteration of Wax with Paraffine.—Ludolt has met with a specimen of wax adulterated with paraffine. He detected the adulteration in the following way

Dingler's Polytech. Journal, Bd. clx. s. 224) :—He heated a piece of the wax with an excess of fuming sulphuric acid. When the wax melted a strong action took place, and when the evolution of vapour ceased the heat was continued a little longer, and then the mixture was allowed to cool. After cooling, the paraffine was found as a transparent layer upon the sulphuric acid. So much sulphuric acid must be used, that when the operation is ended the black residue may be fluid, otherwise it is difficult to separate the paraffine. Very small quantities of paraffine, the author says, may be discovered in this way. English sulphuric acid is not convenient for the purpose, as it decomposes the wax but slowly.

MISCELLANEOUS.

For Regularly Cracking Glass, a very expeditious plan is to use a pearl of glass melted with some soda on a platinum wire, heated before the blowpipe; the crack having been previously started with a sharp blade of first-rate cast-steel, made diamond-hard by quickly cooling.—*Dr. L. C. Levoir.*

Coal in California.—We learn from the *Californian Mining and Scientific Press* that a meeting of the members of the California Academy of Sciences, was held in San Francisco on May 15, at which Professor Blake gave an interesting description of the coal regions of Monte Diabola, accompanied with specimens of the coal. The veins are rather thin, but the coal is good bituminous. The fossils of the region belong to the tertiary formations. Professor Whitney is of opinion that the coal was formed from accumulations carried by eddies, and deposited in still water. A considerable quantity of this coal has been taken to San Francisco, and it has tended to reduce the price of wood and the foreign coal. A plentiful supply of coal in California would tend greatly to facilitate quartz-mining, by enabling the machinery to be operated by cheap steam power. Coal will also make California a great manufacturing State.

The Healthfulness of Fresh Paint in Apartments.—M. Leclerc, a well-known house-painter in Paris, has lately made some experiments to ascertain whether emanations from certain paints containing such substances as white lead, zinc white, linseed oil, essence of turpentine, coal oil, essence of lavender, &c., are injurious to health. He caused the insides of some boxes to be painted, and within them he placed wire cages containing rabbits which were not in contact with the paint but only subject to the influence of the emanations from it. The rabbits suffered while the paint was fresh, especially when it contained coal oil, but none of them died. It is thus proved that living in apartments recently painted, and which emit the odour of the oil of turpentine is not permanently injurious to health. M. Leclerc made, also, some other experiments for the purpose of obtaining deposits of these emanations from the fresh paintings of houses. Instead of rabbits he placed plates containing a small quantity of water in these chests. After the water had evaporated from the plates, he found some remarkable crystallizations like needles, which consisted of combinations in which the oils or essences employed formed the principal part. These crystalline combinations were obtained even when linseed oil was used. M. Deville had previously obtained similar crystallizations, but under entirely different circumstances. After these experiments and their results had been explained to the Academy of Sciences, M. Chevreul added that M. Leclerc had opened a new path of discovery for scientific men, which even Chemists might follow with profit.—*Mechanics' Magazine.*

British Association for the Advancement of Science.—The thirty-first meeting of the British Association for the Advancement of Science will commence in Manchester on Wednesday, September 4, 1861, under the presidency of William Fairbairn, Esq., L.L.D., F.R.S. The General Committee will meet on Wednesday, September 4, at one a.m., for the election of sectional officers and the despatch of business usually brought before that body. On this occasion there will be presented the Report of the Council, embodying their proceedings during the past year. The general committee will meet afterwards by adjournment. The first general meeting will be held on Wednesday, September 4, at eight p.m., when the President will deliver an address; the concluding meeting on Wednesday, September 11, at three p.m., when the Association will be adjourned to its next place of meeting. At two evening meetings, which will take place at eight p.m., discourses on certain branches of science will be delivered. There will also be other evening meetings, at which opportunity will be afforded for general conversation among the members. The committees of Sections will meet daily from Thursday, September 5, to Tuesday, September 10, inclusive, at ten a.m., precisely. The following are the titles of the sections to which communications may be presented :—Section A. Mathematics and Physics; Section B. Chemistry and Mineralogy, including their Applications to Agriculture and the Arts; Section C. Geology; Section D. Zoology and Botany, including Physiology, sub-section D.; Section E. Geography and Ethnology; Section F. Economic Science and Statistics; Section G. Mechanical Science. Notices or communications intended to be read to the Association, accompanied by a statement whether the author will be present or not at the meeting, may be addressed to Professor Phillips, M.A., LL.D., F.R.S., Assistant-General Secretary, University Museum, Oxford; or to R. D. Darbishire, Esq., B.A., F.G.S., Alfred Neild, Esq., Arthur Ransome, Esq., M.A., and Professor Roscoe, B.A., Local Secretaries, Manchester. Gentlemen desirous of attending the meeting will find in the reception room (the Portico, in Mosley Street) blank forms of proposal, and may make their choice of being proposed as life members, paying ten pounds as a composition, or annual subscribers, paying one pound annually and an admission fee of one pound (making together two pounds on admission); or associates for the meeting, paying one pound. Ladies may obtain tickets, through the application of a member, in the reception-room, price one pound each ticket. These tickets are transferable to other ladies only.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

E. T.—Mr. Perkin's address is Greenford Green, Sudbury, N.W.

H. C. S. E.—We will propose you, if you wish to become a Member.

Titanic Acid.—F. S.—To detect this acid in the presence of silicic acid, treat the silicic acid with hydrofluoric acid. Fuse the residue with metallic zinc and microcosmic salt; after the combustion of the zinc and clearing of the lead, on cooling, a very distinct colouration is always produced, whereas the button of microcosmic salt and titanic acid gives no reaction in the ordinary way. By this test (which is recommended by Riley) titanic acid may be found in pig iron.

Specific Gravity writes as follows :—"Would it be possible in the quantitative analysis of waters, having obtained the specific gravity, to calculate thence the total amount of solid matter contained in any volume? Hence, suppose the s. g. of a sample of water to be 1·004—the weight of an Imperial gallon of such water would be 1·004 × 70,000 = 70,280 grs. Now, as an Imperial gallon of distilled water is 70,000 grs., is not the amount of solid matter contained in one gallon of the water under examination the difference in weight = 280 grs.? If this is the case, it saves the long and tedious operation of evaporating down to obtain the same result. And *vice versâ*, knowing the weight of the total solid contents, cannot you calculate th s. g.

THE CHEMICAL NEWS.

VOL. IV. No. 89.—August 17, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Gerhardt's Equivalents and Notation.

(Continued from vol. iii. p. 373.)

FURTHER examples, illustrating the relations between the atomic weights of compounds and their specific gravities, are given in the following table:—

Name of Substance.	Formula.	Atomic weight.	Specific gravity of vapour.	Atomic volume.
Carbonic oxide . . .	$\overline{C}\overline{O}$	28	13·950	2
Carbonic anhydride .	$\overline{C}\overline{O}_2$	44	21·973	2
Phosgene gas . . .	$\overline{C}\overline{O}Cl_2$	99	49·931	2
Bisulphide of carbon .	$\overline{C}\overline{S}_2$	76	38·121	2
Sulphurous anhydride	$\overline{S}\overline{O}_2$	64	32·031	2
Sulphuric anhydride .	$\overline{S}\overline{O}_3$	80	43·243	2
Phosphoretted hydrgn.	H_3P	34	16·792	2
Trichloride of arsenic	$AsCl_3$	181·5	90·819	2
Ethyl-alcohol . . .	$\overline{C}_2H_6\overline{O}$	46	23·254	2
Ethyl-ether	$\overline{C}_4H_{10}\overline{O}$	74	36·973	2
Methyl-ethyl-ether .	$\overline{C}_3H_8\overline{O}$	60	31·005	2
Acetic acid	$\overline{C}_2H_4\overline{O}_2$	60	30·558	2
Acetic anhydride . .	$\overline{C}_4H_6\overline{O}_3$	102	50·018	2
Acetate of ethyl . .	$\overline{C}_4H_8\overline{O}_2$	88	44·209	2
Aldehyde	$\overline{C}_2H_4\overline{O}$	44	22·082	2
Ethylene	$\overline{C}_2H_4$	28	14·131	2
Marsh gas	$\overline{C}H_4$	16	8·038	2
Chloroform	$\overline{C}HCl_3$	119·5	60·539	2
Tetrachloride of carbon	$\overline{C}Cl_4$	154	76·828	2
Camphor	$\overline{C}_{10}H_{16}\overline{O}$	152	76·604	2
Ethylamine	$\overline{C}_2H_7N$	45	22·630	2

The relation between atomic weight and specific gravity in the state of vapour (vapour density) which we have pointed out, has been so uniformly observed, that chemists are inclined to doubt the exactitude of the formulæ of all compounds the atomic weight of which does not yield two volumes of vapour, and the determination of the vapour density of a compound has thus become one of the most important means of controlling chemical formulæ.

The discrepancy in the vapour volumes furnished by the elementary and compound atoms, the former corresponding, as has been pointed out, to one volume, while the latter represent two volumes, has led Gerhardt to the revival of a hypothesis which had been previously countenanced by several inquirers. This hypothesis assumes that the elementary atoms are incapable of existing in the free state, and that whenever elementary atoms are liberated they combine, so to say, with themselves, and separate in pairs, which pairs of atoms may be called the molecules of the elements. We thus arrive at a rigorous distinction between the terms representing the smallest quantities in which the elements enter into combination; the latter the smallest quantity of an element capable of existing in a free state.

The molecules of the elements possessing, as they do, the double weight of the atoms, correspond, with the exception of phosphorus and arsenic (see p. 702), to 2 volumes of gas or vapour.

Name of Element.	Specific gravity.	Atomic weight.		Atomic volume.	Molecular weight.		Molecular volume.
Hydrogen .	1	H	1	1	HH	2	2
Oxygen. .	16	$\overline{O}$	16	1	$\overline{O}\overline{O}$	32	2
Sulphur .	32	$\overline{S}$	32	1	$\overline{S}\overline{S}$	64	2
Chlorine .	35·5	Cl	35·5	1	ClCl	71	2
Bromine .	80	Br	27	1	BrBr	160	2
Iodine . .	127	I	1	1	II	254	2
Nitrogen .	14	N	14	1	NN	28	2
Phosphorus	62	P	31	½	PP	62	1
Arsenic . .	150	As	75	½	AsAs	150	1
Mercury .	100	Hg	100	1	HgHg	200	2

It is thus seen that the molecules of the elements, like the atoms of compounds, correspond to 2 volumes of vapour, and that if we adopt for the elements the double symbols as designating the molecules, all chemical formulæ, with the exception of those of phosphorus and arsenic, represent weights of matter simple or compound, which in the state of gas or vapour occupy the same volume.

The assumption that the elementary molecules consist of two atoms, is not capable of being proved directly, but it is supported by many considerations and analogies which are chiefly taken from organic chemistry. The limits of this outline will only admit the chief argument to be mentioned here.

The researches of the last ten or twelve years have led to the preparation of a series of hydrocarbons, which are considered as the radicals of the alcohols. The radicals methyl, ethyl, propyl, butyl, amyl, and caproyl have been successively examined. The composition of the alcohols to which these radicals belong, being—

Methylic alcohol ($\overline{C}H_3$) $H\overline{O}$,
Ethylic alcohol ($\overline{C}_2H_5$) $H\overline{O}$,
Propylic alcohol ($\overline{C}_3H_7$) $H\overline{O}$,
Butylic alcohol ($\overline{C}_4H_9$) $H\overline{O}$,
Amylic alcohol ($\overline{C}_5H_{11}$) $H\overline{O}$,
Caproylic alcohol ($\overline{C}_6H_{13}$) $H\overline{O}$,

nothing appeared more justifiable than the formulæ,—

$\overline{C}H_3$ for methyl,	$\overline{C}_4H_9$ for butyl,
$\overline{C}_2H_5$ for ethyl,	$\overline{C}_5H_{11}$ for amyl,
$\overline{C}_3H_7$ for propyl,	$\overline{C}_6H_{13}$ for caproyl,

which were originally proposed for these hydrocarbons. A more minute examination of these compounds, however, very soon led chemists to double these formulæ. It is only thus that they represent quantities yielding 2 volumes of vapour, like all other compounds, and that the differences of boiling-point exhibited by these substances are made to accord with the experience on boiling-points derived from numerous other observations. In the following Table the formulæ, atomic weights,

vapour-densities, atomic volumes, and boiling-points of the six substances in question are united:—

Name.	Formula.	Atomic weight.	Sp. gr. of vapour.	Atomic volume.	Boiling point.
Methyl	$C_2H_6 = (CH_3)\ (CH_3)$	30	15	2	Unknown.
Ethyl	$C_4H_{10} = (C_2H_5)\ (C_2H_5)$	58	29	2	Unknown,
Propyl	$C_6H_{14} = (C_3H_7)\ (C_3H_7)$	86	43	2	154°·4, 68° C.
Butyl	$C_8H_{18} = (C_4H_9)\ (C_4H_9)$	114	57	2	226°·4, 108° C.
Amyl	$C_{10}H_{22} = (C_5H_{11})\ (C_5H_{11})$	142	71	2	311°·0, 155° C.
Caproyl	$C_{12}H_{26} = (C_6H_{13})\ (C_6H_{13})$	170	85	2	395°·6, 202° C.

The difference between the boiling-points of propyl and butyl is 226°·4 — 154°·4 = 72°·0 (108° — 68° = 40° C.); that between the boiling-points of butyl and amyl, 311° — 226°·4 = 84°·6 (155° — 108° = 47° C.); and lastly, the difference between the boiling-points of amyl and caproyl, 395°·6 — 311° = 84°·6 (202° — 155° = 47° C.)

According to Kopp's observations, an increment of $C_2H_2 = CH_2$ in composition raises the boiling-point 36°·3 = 19°·9 C. (see p. 499.) The boiling-points of propyl, butyl, amyl, and caproyl unmistakeably show that these bodies differ in composition not by CH_2 as implied in the formulæ

$$C_3H_7,\ C_4H_9,\ C_5H_{11},\ \text{and}\ C_6H_{13},$$

but by

$$2CH_2 = C_2H_4,$$

as implied by the formulæ,—

$$C_6H_{14},\ C_8H_{18},\ C_{10}H_{22},\ \text{and}\ C_{12}H_{26}.$$

If methylic, ethylic, propylic, butylic, amylic, and caproylic alcohols be viewed as water in which one atom of hydrogen is replaced respectively by the compound atoms

methyl CH_3, ethyl C_2H_5, butyl C_4H_9, amyl C_5H_{11}, and caproyl C_6H_{13},

$\left.\begin{matrix}H\\H\end{matrix}\right\}O$, $\left.\begin{matrix}(CH_3)\\H\end{matrix}\right\}O$, $\left.\begin{matrix}(C_2H_5)\\H\end{matrix}\right\}O$, $\left.\begin{matrix}(C_3H_7)\\H\end{matrix}\right\}O$,

Water. Methylic Alcohol. Ethylic Alcohol. Propylic Alcohol.

$\left.\begin{matrix}(C_4H_9)\\H\end{matrix}\right\}O$, $\left.\begin{matrix}(C_5H_{11})\\H\end{matrix}\right\}O$, $\left.\begin{matrix}(C_6H_{13})\\H\end{matrix}\right\}O$.

Butylic Alcohol. Amylic Alcohol. Caproylic Alcohol.

it becomes probable, from the boiling-point relations alluded to, that the compound atoms

$$CH_3,\ C_2H_5,\ C_3H_7,\ C_4H_9,\ C_5H_{11},\ \text{and}\ C_6H_{13},$$

in the moment of their liberation, combine with themselves, giving rise to what we may now call the compound molecules,

$$(CH_3, CH_3),\ (C_2H_5, C_2H_5),\ (C_3H_7, C_3H_7),\ (C_4H_9, C_4H_9),$$
$$(C_5H_{11}, C_5H_{11}),\ \text{and}\ (C_6H_{13}, C_6H_{13}),$$

The methyl-, ethyl-, propyl-, &c., atoms, such as exist in the alcohols, correspond to the atom of hydrogen (to H = 1) such as we assume it to exist in combination. The methyl-, ethyl-, propyl-, &c., molecules which exist in the free state, consisting, as they do, of two atoms of these radicals, correspond to the molecule of hydrogen, which consists itself of two atoms of hydrogen.

(To be continued.)

On Liquid Diffusion Applied to Analysis,[1] *by* T. Graham, *Esq., F.R.S., Master of the Mint.*

The unequal diffusibility of different substances in water appears to present means of separation not unlike those long derived from unequal volatility. For, as regards diffusion, there exists a "volatile," and also a "fixed" class of substances; and these distinctions appear to correspond with differences in molecular constitution of a fundamental nature. Much value is attached to diffusion, as affording the means of bringing out clearly, and subjecting to numerical expression, the distinctive properties of what appear to be two great divisions of chemical substances.

The first, or *diffusive* class of substances, are marked by their tendency to crystallise, either alone or in combination with water. When in a state of solution they are held by the solvent with a certain force, so as to effect the volatility of water by their presence. The solution is generally free from viscosity, and is always sapid. Their reactions are energetic and quickly effected. This is the class of *crystalloids.*

The other class, of low diffusibility, may be named *colloids,* as they appear to be typified by animal gelatine. They have little if any tendency to crystallise, and they affect a vitreous structure. The planes of the crystal with its hardness and brittleness are replaced in the colloid by rounded outlines with more or less softness and toughness of texture. Water of crystallisation is represented by water of gelatination. Colloids are held in solution by a feeble power, and have little effect on the volatility of the solvent. They are also precipitated from their solution by the addition of crystalloids. The solution of colloids has always a certain degree of viscosity or gumminess when concentrated. They appear to be insipid, or wholly tasteless, unless when they undergo decomposition upon the palate and give rise to sapid crystalloids. Their solid hydrates are gelatinous bodies. They are united to water with a force of low intensity; and such is the character of the combinations in general between a colloid and a crystalloid, even although the latter may be a powerful re-agent in its own class, such as an acid or an alkali. In their chemical reactions, the crystalloidal appears the energetic form, and the colloidal the inert form of matter. The combining equivalent of the colloid appears always to be high, and it has a heavy molecule. Among the colloids rank hydrated silicic acid, and a number of soluble hydrated metallic peroxides, of which little has hitherto been known; also starch, the vegetable gums and dextrin, caramel, tannin, albumen, and vegetable and animal extractive matters. The peculiar structure and chemical indifference of colloids appear to adapt them for the animal organisation, of which they become the plastic elements.

Although the two classes are widely separated in their properties, a complete parallelism appears to hold between them. Their existence in Nature appears to call for a corresponding division of chemistry into a crystalloid and a colloid department.

Although chemically inert in the ordinary sense, colloids possess a comparative activity of their own, arising out of their physical properties. While the rigidity of the crystalline structure shuts out external impressions, the softness of the gelatinous colloid partakes of fluidity, and enables the colloid to become a medium for liquid diffusion, like water itself. The same

[1] Read before the Royal Society, June 6th, 1861.

penetrability appears to take the form of a capacity for cementation in such colloids as can exist at a high temperature. Hence a wide sensibility on the part of colloids to external agents. Another eminently characteristic quality of colloids is their mutability. Their existence is a continued metastasis. A colloid may be compared in this respect to water while existing liquid at a temperature below its usual freezing point, or to a supersaturated saline solution. The solution of hydrated silicic acid, for instance, is easily obtained in a state of purity, but cannot be preserved. It may remain fluid for days or weeks in a sealed tube, but is sure to gelatinise at last. Nor does the change of this colloid appear to stop at that point; for the mineral forms of silicic acid deposited from water, such as flint, are found to have passed, during the geological ages of their existence, from the vitreous or colloidal into the crystalline condition (H. Rose). The colloidal is, in fact, a dynamical state of matter; the crystalloidal being the statical condition. The colloid possesses energia. It may be looked upon as the probable primary source of the force appearing in the phenomena of vitality. To the gradual manner also in which colloidal changes take place—for they always demand time as an element—may the chronic nature and periodicity of vital phenomena be ultimately referred.

For the separation of unequally diffusive crystalloids from each other, jar-diffusion was had recourse to. The mixed solution was conveyed by means of a pipette to the bottom of a column of water contained in a cylindrical glass jar. A kind of cohobation takes place, a portion of the most diffusive substance rising and separating from the less diffusive substances, more and more completely as it ascends.

The separation of a crystalloid from a colloid is more properly effected by a combination of diffusion with the action of a septum composed of an insoluble colloidal material. Animal membrane will serve for the latter purpose, or a film of gelatinous starch, hydrated gelatin itself, albumen, or animal mucus. But by much the most effective septum used was paper, as it is metamorphosed by sulphuric acid (Gaine). It is now supplied by Messrs. De La Rue, and has become familiar under the name of "vegetable parchment," or "parchment paper." From sheet gutta percha a flat hoop is formed, eight or ten inches in diameter by three inches in depth, and one side is covered by a disc of parchment paper, so as to form a vessel like a sieve. A mixed solution, which may be supposed to contain sugar and gum, is placed upon the septum to a depth of half-an-inch, and the instrument then floated upon a considerable volume of water contained in a basin. Three-fourths of the sugar diffuses out in twenty-four hours, and so free from gum as to be scarcely affected by subacetate of lead, and to crystallise on the evaporation of the external water by the heat of a water-bath.

The unequal action of the septum, which causes the separation described, appears to depend upon this:—The crystalloid sugar is capable of taking water from the hydrated colloidal septum, and thus obtains a medium for diffusion; but the colloid gum has little or no power to separate the combined water of the same septum, and does not, therefore, open the door for its escape by diffusion, as the sugar does. This separating action of the colloidal septum is spoken of as *dialysis*.

Dialysis was applied to the preparation of various colloids. The mixed solution obtained by pouring silicate of soda into water acidulated with hydrochloric acid, was placed upon a parchment paper dialyser and allowed to diffuse into water, the latter being occasionally changed. After the lapse of five days, seven-eighths of the original silicic acid was found to remain liquid upon the septum, and to be so free from hydrochloric acid and chloride of sodium as not to give a precipitate with acid nitrate of silver. The true hydrated alumina, and also Mr. Crum's metalumina, were obtained soluble by dialysing solutions of these oxidas in the chloride and acetate of the same metal. So also the hydrated peroxide of iron, in addition to the hydrated metaperoxide of iron of M. Péan de Saint-Gilles, and the soluble hydrated chromic oxide. The varieties of Prussian blue are obtained soluble by dialysing their solution in oxalate of ammonia, the latter salt diffusing away. Stannic and titanic acids appear as insoluble gelatinous hydrates.

A solution of gum arabic (gummate of lime), dialysed after an addition of hydrochloric acid, gave at once the pure gummic acid of Frémy. Soluble albumen is obtained in a state of purity by dialysing that substance with an addition of acetic acid.

Caramel of sugar, purified by repeated precipitation by alcohol and afterwards by dialysis, contains more carbon than any of the caramelic bodies of Gélis; it forms a tremulous jelly when concentrated, and appears decidedly colloidal. Caramel, like all other colloids, has a soluble and an insoluble modification. The latter has its solubility restored by the action of alkali followed by that of acetic acid and subsequent dialysis.

Dialysis proves highly useful in separating arsenious acid and metallic poisons from organic fluids. Defibrinated blood, milk, and other organic fluids charged with a few milligrammes of arsenious acid, and placed upon the dialyser were found to impart the greater proportion of the arsenious acid to the external water in the course of twenty-four hours. The diffusate was so free from organic matter, that the metal could be readily precipitated by sulphuretted hydrogen, and the quantity weighed.

Ice, at or near its melting point, appears to be a colloidal substance, and exhibits a resemblance to a firm jelly in elasticity, the tendency to rend, and to redintegrate on contact.

The consideration of the properties of gelatinous colloids appears to show that osmose is principally an affair of the dehydration of the gelatinous septum under influences having a catalytic character, and that the phenomenon is independent of diffusion. The colloidal septum is capable of hydrating itself to a higher degree in contact with pure water than in contact with a saline solution. Colloidal septa, swollen in consequence of contact with dilute acid or alkali, appear to acquire increased sensibility to osmose, in consequence of their unusually high degree of hydration.

On Didymium, Lanthanum, Cerite, and Lanthano-Cerite, by R. Hemmann.

(*Continued from page* 73.)

Sulphide of Didymium is formed by heating the oxide in the vapour of bisulphide of carbon. It is a light, greenish-brown powder, evolving sulphuretted hydrogen with dilute acids, and, when heated, smouldering to a mixture of oxide and basic sulphate.

Oxysulphide of Didymium is obtained by fusing oxide of didymium and sulphide of sodium. When the mass is treated with water, Di_2OS remains as a gray residue, which dissolves in hydrochloric acid with evolution of HS.

Hydrated Oxide of Didymium.—Solutions of didymium salts give, with hydrate of potassium or sodium, a slimy, transparent, bluish rose coloured precipitate, which dries up to flesh-red pieces of hydrated oxide of didymium, which, however, cannot be obtained by this process free from carbonic acid. Ammonia throws down from solutions of didymium basic salts, which also appear as bulky, transparent precipitates, of a bluish-rose colour.

Chloride of Didymium.—If a solution of the oxide in hydrochloric acid be mixed with a sufficient quantity of sal ammoniac, a double salt is produced, which may be evaporated to dryness without decomposition. If this double salt be heated in a covered platinum crucible to redness, the sal ammoniac passes off, and chloride of didymium remains behind. It forms a rose-red mass, of radiated crystalline structure, and consists of DiCl :—

Di	57·205	1·	593·50	57·24
Cl	42·795	1.	443·28	42·76
	100·000		1036·78	100·00

When chloride of didymium, thus prepared, is dissolved in water, some oxychloride of didymium usually remains behind, in the form of rosy-red, pearly scales. Chloride of didymium deliquesces in moist air, and dissolves easily in alcohol.

Hydrated Chloride of Didymium.—Oxide and peroxide of didymium dissolve easily in hydrochloric acid, forming a rose-coloured fluid, which, when evaporated to a syrupy consistence, solidifies to a granular mass of crystals. According to Marignac, these crystals are monoklinoëdric, and consist of the combination ∞ P.OP (P ∞). ∞ P 78°; OP : ∞ P 92°; (P ∞) : (P ∞) on OP 67°. The composition is DiCl+4HO.

Oxychloride of Didymium. — When hydrated chloride of didymium is heated, there passes off, besides water, much hydrochloric acid. There is thus formed the oxychloride as a white powder, insoluble in water and slowly and with difficulty soluble in hydrochloric acid.

Double Chloride of Didymium and Mercury, obtained by evaporating the chlorides of didymium and mercury, forms rose-red cubes. It is easily soluble in water, but not deliquescent. Its composition is DiCl + 3HgCl + 8HO (Marignac).

Bromate of Didymium forms light, rose-red, permanent hexagonal prisms. Combination : ∞ P.P.P ; P 147° 58′ (terminal edges), 67° (lateral edges). Composition, $DiO.BrO_5 + 6HO$.

Fluoride of Didymium.—Fluoride of sodium produces a precipitate in solutions of didymium salts, only slightly soluble in hydrochloric acid.

Carbonate of Didymium, obtained by precipitating didymium salts with bicarbonate of ammonia forms a light rose-red, which, when dried *in vacuo*, consists of $DiOCO_2 + 2HO$. Dried at 100°, it has the composition $2DiOCO_2 + HO$ (Marignac).

Nitrate of Didymium.—Oxide and peroxide of didymium dissolve easily in nitric acid, forming a rose-red liquid. By evaporation, the syrupy solution acquires an amethystine colour, and solidifies, after standing some time over sulphuric acid, to a crystalline mass, which deliquesces in moist air and dissolves easily in alcohol. When heated in the air it is converted into peroxide of didymium.

Arseniate of Didymium.—Arsenic acid gives with didymium salts a pulverulent precipitate only when boiled. Arseniate of potassium, on the contrary, produces, even in the cold, a slimy precipitate. Both precipitates, when dried *in vacuo*, consist of $3DiO, 2AsO_5 + 2HO$ (Marignac).

Phosphate of Didymium, $3DiO2PO_5 + 5HO$. If a cold solution of sulphate of didymium be mixed with its equivalent of phosphoric acid,—viz., one atom phosphoric acid to three atoms oxide of didymium, two-thirds of the didymium are thrown down as phosphate of didymium, while one-third remains dissolved in the free acid. The phosphate of didymium so prepared forms a flocculent precipitate, which, dried at the temperature of the air, possesses the above composition. We obtain in fact,—

DiO . . .	53·88	3 = 2080·5	53·82
PO_5 . . .	46·12	2 = 1784·6	46·18
	100·00	3865·1	100·00
$3DiO, 2PO_5$	87·19	1 = 3865·1	87·30
HO . . .	12·81	5 = 562·5	12·70
	100·00	4427·6	100·00

The phosphate of didymium which remains dissolved in the free acid is thrown down by ammonia as a transparent, pasty precipitate, which dries up at the temperature of the room to transparent pieces of a beautiful rose-red colour, and with conchoidal fracture. By precipitating a hot solution of sulphate of didymium with phosphoric acid, Marignac obtained a pulverulent, white phosphate of didymium, of the composition $3DiO, PO_5 + 2HO$.

Sulphite of Didymium, $DiOSO_2 + 2HO$ (dry) (Marignac). Oxide of didymium dissolves in aqueous sulphurous acid, forming a rose-red liquid, from which, on the application of heat, a voluminous precipitate separates, but which dissolves again on cooling, when the fluid still contains an excess of sulphurous acid.

Basic Sulphate of Didymium, obtained by precipitating sulphate of didymium with excess of ammonia, forms a light-bluish, rose-red, transparent precipitate, which dries up at the temperature of the air to pieces, with an earthy fracture and a rose-red colour, $3DiO + SO3 + 8HO$.

Sulphate of Didymium.—Oxide and peroxide of didymium dissolve easily in sulphuric acid, forming a rose-red liquid. By evaporation, whether spontaneously or by the aid of heat, it forms dark, rose-red, granular crystals of hydrated sulphate of didymium. According to Marignac, the form of these crystals is monoklinoëdric. The composition of this salt was found to be the same by the author as that determined by Marignac. It expresses, in fact, the unusual formula $3(DiOSO_3) + 8HO$.

Oxalate of Didymium.—Oxalic acid and oxalate of ammonia produce in solutions of didymium salts at first a caseous precipitate, which, however, soon sinks together to a crystalline, light, rose-red powder. Dried at 15°, the compound consists of $DiOC_2O_3 + 4HO$. Dried at 100°, it consists of $DiOC_2O_3 + HO$.

(To be continued.)

On the Production of the Ethyl Bases,[1] *by M.* Carey Lea, *Philadelphia.*

I mentioned in a former number of this Journal that while engaged in the examination of the action of am-

[1] *American Journal of Science and Arts.*

ammonia on certain oxy-ethers, I had met with the experiments of Juncadella and De Clermont, and finding that the production of ethylamine by these reactions had been already indicated, I discontinued my investigations. Subsequently, however, having occasion to prepare a considerable quantity of ethylamine for other examinations, I determined to ascertain whether the action of nitrate of ethyl on ammonia could not be made use of as a convenient process. Juncadella had already proposed to mix nitrate of ethyl with three or four parts of alcohol, saturate the mixture with dry ammoniacal gas, and heat for two days to 212° in the water bath. This was a rather troublesome process, and a few experiments led me to the following very simple method, which I publish as having given me satisfactory results.

Nitrate of ethyl is mixed with an equal volume of strong alcohol. To this mixture is added a quantity of ordinary strong liquid ammonia, equal in bulk to that of the mixture. The nitrate of ethyl is thereby precipitated, but is nevertheless easily acted upon by the ammoniacal liquid. Three hours in the water-bath at 212° is generally sufficient to complete the reaction. As the process goes on, the nitrate of ethyl becomes brownish, gradually diminishes, and finally disappears. The resulting solution does not contain salts of ammonia and ethylamine only, as has been stated, but a large quantity of diethylamine and triethylamine.

As the nitrate of ethyl can be prepared in large quantity with great facility by a modification of M. Millon's process, I am inclined to think that this process will be found valuable for the preparation of the ethyl bases. It is necessary that the tubes should be strong, and not more than two-thirds full. Bottles hermetically sealed are not to be recommended unless extremely strong. In one experiment I operated with four eight-ounce bottles, all of which stood the test, but on repeating the process three of the four exploded at once, and the fourth subsequently.

The presence of alcohol is far from being essential. Nitrate of ethyl is readily decomposed at 212° by aqueous ammonia, and if the ammonia is in considerable excess, the decomposition is complete in three hours. If the excess is only slight, the time required for decomposition is greatly increased. In one experiment where 29 parts of nitrate of ethyl were heated with 57 of liquid ammonia, the decomposition was not complete till at the end of 15 hours. The use of alcohol, and the proportions above given, are what was found to give the most satisfactory result.

TECHNICAL CHEMISTRY.

On the Origin and Progress of the Phosphorus and Match Manufactures, by G. Gore.

(*Continued from page 79.*)

The latest improvement of note in the manufacture of matches is that of M. Lundstrom, of Jonkoping, in Sweden. It consists in dividing the ingredients of the match mixture into two separate compositions, one being placed upon the ends of the splints as usual, and the other, which contains the phosphorus, being spread in a thin layer upon the end or lid of the box. The patentee uses the following mixture for the splints:—

Chlorate of potash . . .	6 parts.
Sulphide of antimony . .	2 to 3 „
Glue	1 „

and the following for the friction surface, which has been previously made rough by a coating of glue and sand:—

Amorphous phosphorus . .	10 parts.
Sulphide of antimony, or peroxide of manganese . .	8 „
Glue	3 to 6 „

By this method the danger of fires arising from ignition of the matches by friction is avoided (because the matches will ignite by rubbing upon no other surface besides the prepared one); and that of poisoning is totally prevented by using the red or innocuous variety of phosphorus.

There is scarcely any manufacture of which the statistics appear more fabulous than that of match-making. To begin with England, in which the manufacture is comparatively small. The firm of Messrs. Dixon, Newton Heath, employ about 300 workpeople on the premises, and upwards of 100 at their own homes. Their stock of timber is generally of the value of about 8000*l.* or 10,000*l.* They consume 1 ton of sulphur per week, in the sulphuring of splints; and in twelve months they use between 4 and 5 tons of chlorate of potash, and 12 tons of glue. They produce about 43,000,000 of matches every week, or 2,160,000,000 matches yearly; reckoning the length of a match at 2½ inches, the total length of these would far exceed the circumference of the earth. In London a single saw-mill cuts up 400 large timbers annually to make splints for matches. It has been estimated that from 12,000 to 15,000 gross of boxes of matches are produced weekly in London, indicating a production of 5,000,000,000 of matches yearly in that city. And another calculation has been made that the whole length of waxed cotton wicks consumed by one London manufacturer in the production of "Vestas" would be sufficient to reach from England to America and back again. One pound of phosphorus is sufficient for tipping 1,000,000 of German matches, or for 600,000 English ones.

The yearly consumption of phosphorus in the manufacture of matches in this country has been estimated at 6 tons, which, at a price of 2s. 6d. a pound, amounts to a value of 1680*l.*; and of chlorate of potash, 26 tons. A single merchant of London imports 8000 cwt. of cases of matches yearly. In 1854, 20,000*l.* worth of matches came into this country from the city of Hamburgh alone. We import at the present time at least 1500 tons of matches a-year from Sweden only. It has been estimated that 60,000*l.* worth of matches are imported yearly into Great Britain,—equal to 200,000,000 of matches daily; and that our daily consumption approaches the enormous number of 250,000,000, or more than 8 matches each day for every individual in the kingdom. In Belgium, the consumption of matches has been calculated to be 9 matches per day for every living person.

In France, the manufacture of matches is very extensive. Paris alone employs 1000 operatives, and produces 990,000,000 of boxes, worth in total 7200*l.* yearly. In Sweden there are 6 or more manufactories of matches; in one of them, in 1848, there was employed about 400 workpeople, and produced between 8,000,000 and 10,000,000 of matches daily.

But the greatest seat of match-making is located in Austria, where there are numerous manufactories which produce many millions per day of phosphorus matches: for instance, those of M. Pollak, at Vienna, and M. Fürth, in Bohemia, consume together about 20 tons of phosphorus annually, and give employment to about

*

6000 persons; and as one pound of phosphorus suffices for upwards of 1,000,000 of their matches, those two makers alone produce the amazing number of 44,800,000,000 of matches yearly. In the year 1849, there was exported from the port of Trieste alone nearly 200 tons of lucifer matches, and the whole produce of matches in Austria in that year was estimated at 2500 tons.

The cost at which both boxes and matches are produced is equally startling. M. Fürth "sells his cheapest boxes at one penny per dozen, each box containing 80 matches." Peter Harrass, of Suhl, in Prussia, sells his plain boxes at twopence per 100, and 1400 splints for one farthing. And De Majo, of Moravia, "sells a case of 50 boxes, each containing 100 lucifers, for fourpence."

Notwithstanding the great and universal advantages conferred upon mankind by the introduction of phosphorus into the manufacture of matches, it is not without some serious drawbacks. It produces a most painful disease, which attacks the jaw-bones of the workpeople, and causes them to decay, until, in some casas, they are entirely destroyed. This disease only attacks the operatives who are exposed to vapours arising from the match composition,—chiefly those who dip the splints, also those who are occupied in drying, cutting, and boxing the dipped matches. The workmen employed in other parts of the manufacture are wholly unaffected. The disease has been fearful in Germany and France, where so much phosphorus is used in the match composition, so much so as to excite the attention of the Governments of those countries; but it has not appeared to so great an extent here. It may be considerably, if not entirely prevented, by particular attention to cleanliness and ventilation, which has been already proved in the establishment of Mr. Hynam, of London; the most effectual remedy, however, would consist in the use of amorphous phosphorus instead of the ordinary variety. It is to be remarked, that in the manufacture of the phosphorus itself, the experience of many years has shown an almost complete immunity from any symptom of the disease; this may be partly attributed to the fact that the substance is kept covered with water from its first production to the vessels in which it is finally packed for sale.

Another great disadvantage is, that ordinary phosphorus is highly poisonous, and several instances are upon record where children have been killed through sucking the composition from the ends of matches. It might be also used for intentional poisoning, especially as phosphorus exists naturally to a large amount in the tissues of the human body; and phosphorus introduced into the stomach becomes gradually converted into phosphoric acid, which cannot readily be distinguished from that naturally present. The amorphous variety could not produce poisoning either by accident or intention, for Dr. De Vry, of Rotterdam, has administered it in various doses to animals without producing any ill effects.

Conflagrations have also frequently resulted from ordinary phosphorus matches, which could not possibly have occurred with the matches made with amorphous phosphorus under the patent of M. Lundstrom, already mentioned. In the records of fire insurance, we find that calamitous fires have been produced by cats knocking down boxes of matches, and by rats gnawing the ends of matches.

Let us endeavour to draw a useful lesson from the facts we have recorded,—not to despise or think lightly of the abstract facts or "small beginnings" of philosophers, but rather to foster them, with a hope that, sooner or later, they may become of value to ourselves or our successors. Who would have thought that the curious, stinking, unctuous, luminous wax of Master Brandt would ever have become so important and universal an agent of civilization? That great modern innovator, the scientific faculty of man, has, by the certain process of experiment and induction, so immensely improved the means of producing phosphorus, and so marvellously adapted its properties to the uses and requirements of domestic and general life, that it has extended the civilising and ameliorating influence of the lucifer match to the uttermost ends of the earth. The matches of London, Manchester, and Vienna, are to be seen in the wigwam of the far-west Indian, the bush dwelling of the Australian, the habitation of the Mussulman, the frozen hut of the Greenlander, the hovel of the peasant, and the palace of the Emperor. Everywhere, as commerce extends its boundaries into newly-discovered regions, it is one of the first articles of civilisation which is introduced.

On the Preparation of Rosolic Acid and of Rosolates, by M. Jouvin.

M. Runge, in 1834, having remarked that in certain portions of a gas-making apparatus, the lime found therein became red, endeavoured to separate this coloured matter, and gave to it the name of rosolic acid, but without having well defined it.

In 1854, Mr. McDougall, a Manchester manufacturer, having observed that the lime used in the preparation of disinfecting coal-tar became, after a certain time, more or less red, took some of this substance to Dr. Smith, a chemist in the same town. After more attentive study than M. Runge had bestowed upon it, Dr. Smith succeeded in separating from it a solid brown substance, becoming yellow when dissolved in alcohol, and red on the addition to it of an alkali or of lime. He retained the name of rosolic acid given by Runge, for the first of these bodies, the red colouring matter being then considered as a rosolate.

Wishing to obtain a certain quantity of this acid for analyses, Dr. Smith sought for the most expeditious method,—the process for separating rosolate of lime being not only tedious but yielding small results; for the red lime mentioned contains only a few grammes of rosolate to several kilogrammes of the staple matter.

Supposing that rosolic acid was a modification of phenic acid, existing in the products used for the preparation of coal-tar, Dr. Smith passed phenic acid in vapour over lime in a red-hot tube, and found that the lime became red-hot only after a certain time, and he obtained only a small quantity of rosolate of lime. Then he tried the following process, which he ultimately preferred, as being the most simple. He heated a mixture of phenic acid, soda, and peroxide of manganese, and again obtained, and in larger quantities, the red matter, rosolate of soda.

Thus the question rested, when, having occasion to study phenic acid, I indirectly found Dr. Smith's rosolic acid, without then being aware of his researches; and I found that rosolic acid and rosolates could be much more easily obtained if, in the process given by the Manchester chemist, peroxide of mercury were substituted for peroxide of manganese.

In short, with manganese are obtained, besides rosolate of soda, manganates of soda, which decompose when

it is attempted to separate them for the purpose of purifying the colouring matter, forming oxides of manganese which must be separated, and thus necessitating a lengthened purification, while if oxide of mercury is substituted for the oxide of manganese in the mixture of carbolic acid and soda, we very rapidly obtain (ten minutes suffices), and at a temperature below 150°, the transformation of carbolic into rosolic acid, and the formation of a rosolate of soda of a beautiful red. This salt then appears as an excessively viscous liquid, solidifying almost entirely when cooled, and simply needing decanting to purify it, which frees it from the reduced mercury which remains at the bottom of the vessel.

This colouring matter, obtainable of various tints according to the quantity of oxidising matter employed, has not yet been used for dyeing, on account of its instability under the action of acids, which by neutralising the alkali gives to rosolic acid its arnotto colour; but I trust that trials now in operation will result in utilising it for dyeing.

A fact, which I re-mention here, relating to phenic acid, is, that if heated with bichloride of mercury this acid will also yield rosolic acid, at the same time producing hydrochloric acid; and, with a distilling apparatus, rosolic acid can be collected in the retort, while the excess of phenic acid, saturated with hydrochloric acid, condenses in the receiver and fuming excessively in the air.

Rosolic acid proceeds from oxidised carbolic acid; for if the latter is represented by the formula $C_{12}H_6O_2$, that of the former becomes $C_{24}H_{12}O_6$. This formula is given as the result of three analyses.

On Certain Copper and Zinc Alloys, by M. E. Kopp.

An alloy, patented by M. Gedge (*Dingl. Polyt. Journ.*, vol. clviii. p. 273), remarkable for its malleability—for when hot it can be forged, stamped, rolled, and drawn with the greatest ease—gives, on analysis, the following numbers:—

Copper . . .	60·00
Zinc . . .	38·15
Iron . . .	1·50
	99·65

The proportion of zinc can be increased to 44 per cent. This alloy, which is recommended for sheathing vessels, seems identical with Aich's alloy (*Technologiste*, May, 1861, p. 429), to which the following composition is assigned:—

Copper . . .	60·00
Zinc . . .	38·20
Iron . . .	1·80
	100·00

The colour of this alloy is rather darker than brass; its fracture is paler, bending at a red heat, and of fine grain. It takes a high polish. Its density is 8·37 when annealed, and when hardened 8·40. It is extremely ductile, though not so flexible as brass. Experiments made in the Austrian marine arsenals show that the Aich's metal possesses a high degree of tenacity; that it maintains its properties at red heat, provided the temperature is not raised to a clear red heat; that it can be puddled, hammered, and worked like the best forged iron; that when cold it can be considerably bent without cracking or breaking; that its absolute and relative resistance approximates to that of iron of good quality.

It is very probable that these alloys are nothing more than malleable brass or Chuntz metal, concerning which M. Storer published a most interesting paper in the *Repertoire de Chimie Appl.*, 1860, p. 213. It is very likely that the iron is useful only in diminishing the nett cost of these alloys.—*Repertoire de Chimie.*

On the Manufacture of Iron,[1] *by* E. Riley, *F.C.S., late of the Dowlais Iron Works.*

The author commenced by stating that, having considered the various ores and coals used in the manufacture of iron and the working of the blast-furnace, he should proceed to the pig iron, and the different processes it underwent in its conversion into merchant bars and rails.

The various qualities of pig iron were considered: they were known in commerce by the Nos. 1 to 6, Nos. 1 to 3 being foundry iron, and Nos. 4 to 6 grey forge iron; besides these there was also mottled and white pig. No. 1 iron was only produced when the furnace was in the best working order, and required a heavy burden of coal and limestone; it was, consequently, the most expensive iron to produce; any little irregularity in the blast furnace soon reduced the iron to the lower numbers, at the same time altering the cinder, which was very grey when No. 1 iron was produced.

On referring to the analysis of various qualities of pig iron (from Nos. 1 to 6) it will be seen that the per centage of silicium is directly as the quality of the pig, being the highest in No. 1, and lowest in No. 6; whereas the sulphur is inversely as the quality of the pig, being the lowest in No. 1, and highest in No. 6. The phosphorus is a constant quantity. The samples of pig analysed were made from the same materials. The carbon does not differ very materially in quantity in the grey iron, but as you get on to mottled and white the carbon then becomes either partially or wholly combined with the iron, whereas in very grey iron the carbon all exists as graphite.

When the sulphur is present to any extent in an iron ore it is difficult to obtain grey iron, and when it is in large quantity it becomes almost impossible, unless it be mixed largely with other ores, the effect of sulphur on grey iron being to liberate the carbon and reduce the quality of the iron. Experimentally, if sulphide of iron be mixed with grey iron, graphite is separated, and if the sulphide of iron is used in any quantity the iron becomes white; thus it is that finery and forge cinders always make, when used alone, a white iron, from the high per-centage of sulphide of iron they contain.

In considering the quality of grey pig iron for foundry purposes, it must be admitted that the chemical composition of the pig is not necessarily an indication of its strength; and it is always necessary that its physical condition should be considered, although, as a rule, which generally holds good, you will find that pig iron which contains a high per-centage of silicon is weak, and more especially so when, besides this silicon, the iron contains a high per-centage of phosphorus, which is generally the case in iron made from the oolitic ores. The sulphur cannot be present to any extent in very grey iron; it never exceeds, and is generally below, ·05 per cent. in No. 1 and No. 2 foundry pig. Pig iron, after being re-melted, is generally increased in strength. This is due more to an alteration in its physical condition than

[1] Abstract of a Paper read before the Society of Engineers.

to any chemical change, and is probably due to the iron becoming more homogeneous and uniform throughout. It has been found practically that a very siliceous iron, by being re-melted, was greatly increased in strength, without in any way altering its chemical composition.

It would naturally be asked, has the chemical composition of pig anything to do with its strength, and is not its physical condition the main point? The author considered that the chemical composition was of great importance; at the same time, he admitted that the composition of pig iron was not well understood, more especially as to the way in which the various elements existed and were combined. He also thought that some elements existing in pig had hitherto not been detected; he had himself, in several instances, detected titanium, which, he believed, had not been found before. Again, the elements in pig iron—more especially carbon and silicon—were capable of existing in very different states, known to chemists as allotropic conditions (or the same element existing in a different physical state, and not unfrequently playing a different part in combination). Thus, we have carbon as the diamond, graphite, and charcoal; and we have yet to learn, not only in what condition the two elements above-named exist in various qualities of iron, but also, from the great similarity in many of the properties of them, whether they may not, in fact, replace, to some extent, each other; and thus, possibly, you may have silicon playing the part, and, in fact, become equivalent to, carbon in certain cases.

It has recently been shown, by Professor Brodie, that carbon has, or ought to have, three different atomic weights, and you may have carbon existing in its three states in the various qualities of pig, altering it physically, and differing only chemically, in the aggregation of its atoms, the actual amount of carbon being identical.

Undoubtedly as our knowledge and experience increases we shall be able to give more satisfactory reasons than we can at present, as we are only able to draw general conclusions, which, I believe, as a rule are correct.

Pig iron from various localities was then considered, the Welsh being generally noted for its strength. It was not so fluid as the Scotch and Staffordshire, which was more adapted for light castings. The general effect of silicium and phosphorus was to make iron more fluid, but to diminish its strength. The hot blast iron was also considered more adapted for some castings than others.

Various processes were noticed for toughening pig iron, which generally consisted in reducing the impurities by a process of refining or oxidation, or mixing wrought iron or metal with the pig.

The treatment of the pig in the refinery and the construction of the latter, were next considered. Formerly the pigs were re-melted in the finery, but in many works the iron was run direct from the blast-furnace into it. White pig was much more easily blown than grey pig; the former quality was generally used in Wales for rails and bars, and it is only when the very best quality of iron is made that grey pig is used.

The finery has, however, in many works been superseded, and the pig is taken directly to the forge and puddled. When pig is used in the forge, it is called boiling; when metal puddling, in some works it is still found advantageous to use the finery partially, and it is only when the pig is of good quality that it can be done away with altogether.

The author then referred to diagrams of the puddling-furnace, and noticed the great improvement that had been effected by the use of cast-iron bottoms. They were generally one and a-half to two inches thick, and rested on bars so as to allow the air to keep them cool. In boiling pig, the action of the iron and cinder (which was much more fluid than in puddling) was very great on the sides or boshes of the furnace, and great difficulty was experienced in keeping them intact. Limestone had been found to stand better than anything else, although it made the iron red-hot, and was objectionable on this account. Red ore had been used, and a mixture of red ore, hammer slag, and lime with more or less success; also spathose iron ore had been found to stand very very well, and in America steatite, or soapstone, had been used successfully. Some works had a mixture of their own, which was kept secret, but generally consisted of red ore hammer slag and lime, in various proportions. The maintenance of the boshes of the puddling-furnace was of great importance in an iron works. In Staffordshire, calcined tap cinder was used for the bottoms of puddling-furnaces.

The various qualities of pig, and their working in the forge, were next considered; in Wales, where white pig iron was used, there were two, perhaps three, varieties, which worked very differently in the forge. First, you have what is technically called "strong iron." This iron is more or less siliceous, and cast solid with a convex face when cast in sand or ashes; with a concave face, when cast in chills (cast iron moulds). It is very sonorous, and rings like a bell when struck, and breaks with a perfectly solid white and crystalline fracture. This is the best description of white forge iron, and will make bars or rails of excellent quality.

The next description of white forge iron is when the pig contains a high per-centage of sulphur and phosphorus; the iron is then thick, and runs into the chills or sand with a very rough face, covered with warty excrescences, strikes dead, like lead, when struck, is frequently not solid, and is of a dark white colour; this iron is known as "weak iron," and is always produced from finery and forge cinders, when they are used in any quantity on the blast-furnace.

When very siliceous iron ores are used, the tendency is to get a siliceous pig. Finery and forge cinders do not, as might be anticipated, make a siliceous iron, except when they have been calcined and rendered infusible.

In some cases you have pig iron siliceous, and weak at the same time, from the presence of sulphur and phosphorus. The pig is then of the worst possible kind.

Siliceous pig iron is much more difficult to refine or puddle than weak pig. The author mentioned a case where white pig iron, containing 3¼ per cent. of silicon, was blown for seven hours in a finery, and was not then metal; this pig, when puddled, worked to a yield of 27 cwt. of pig to a ton of puddled bar, and after two heats the men would not work any more. It was found in practice advantageous to mix the strong pig with the weak in the forge. The author considered that silicon, to a certain extent, in forged pig was advantageous. He found that the best white forged pig contained from 1 to 1¼ per cent.; also pig made wholly from Welsh mine contained the same amount. This per-centage of silicon gave what was known as strength to the iron, but when the silicon exceeded the above-named proportion, then the iron became difficult to work; the effect of the silicon was to retard the puddling process, and thus it gave time for the impurities to be more completely separated.

The skill of the puddler was of much importance, and the author warned all engineers not to rely on single

experiments made on the yield of pig iron. The only way to get at the true result was to take the working of a whole forge.

The average quantity of coal used to make a ton of puddle bar in Wales was 17 cwt., in some cases less, and the quantity of pig from 22 to 23 cwt.

The next point considered was the mechanical treatment of the iron. This the author considered a very important one, and quite irrespective of its chemical composition. In most works in Wales the squeezer is used, and in some works a patent squeezer, consisting of three grooved eccentric rollers. The latter was considered preferable to the former. The other mechanical means of compressing the iron were the old tilt hammer and the steam hammer. Formerly the old tilt hammer was the only means of compression used, but since inferior iron has been made by driving the furnaces and using impure ores, the iron would not stand the old tilt, and the squeezer was introduced, by the use of which almost anything can be shingled into a bloom and passed through the rolls, whereas, with the old tilt hammer, the iron from the first has to bear the full weight of the blow. This does not apply to the steam hammer, as with it the blow can be regulated to any nicety.

Lately, engineers, in their specifications, have stipulated that the iron shall be hammered and not squeezed, and the plan has been adopted of doubling the puddle balls by slightly hammering them, placing them one on the other, and welding them into a slab for the head of the rail; this makes the rail head crystalline, and not fibrous, as it is only once submitted to the drawing action of the rolls.

The iron, after squeezing or hammering, is passed through the rolls, and rolled into No. 1 iron or puddle bar, which is cut by shears into the requisite lengths for the subsequent pile.

The different methods of making the various piles for rails, &c., were entered into, the great object in piling being to get the pile as solid as possible and free from interstices. The piles were frequently made of puddle bar, of different widths, piled alternately so as to break the joints, and also, in some cases, the puddle bar was cut in short lengths equal to the width of the pile, and each layer piled at right angles to the previous one. This had a tendency to make the iron less fibrous.

The various sections of rails in use were then alluded to. The double-headed rail generally was made with slabs at the top and bottom of the rail. For the best quality of rails they were about two inches in thickness, and the rails were double heated. Some engineers had their rails made of three hammered slabs, one piled on the other.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Saturday, March 23, 1861.

A Course of Ten Lectures on Inorganic Chemistry, by Dr. Edward Frankland, *F.R.S., Lecturer on Chemistry at St. Bartholomew's Hospital.*

Lecture X.

It is now nearly a century ago since Scheele, the great German chemist, mixed binoxide of manganese with hydrochloric acid. He noticed that a gaseous body was disengaged possessing a greenish yellow colour, and exhibiting very remarkable properties. He investigated it to a certain extent, and the discovery of this remarkable and new element soon attracted the attention of other chemists, especially of several chemists in France, who continued the investigation of the body. The substance was produced, as I have said, by the action of binoxide of manganese—a body, therefore, containing oxygen, and we may say oxygen in excess—upon hydrochloric acid—a compound which at that time was termed "muriatic acid," sometimes, also, "marine acid," as being an acid obtained from sea-salt. On account of this origin of the new substance which Scheele had discovered—namely, its origin in muriatic acid and an oxidising body like binoxide of manganese—it received the name of "oxymuriatic acid." The chemists of that day thought it was produced by the union of oxygen with muriatic acid. This body being discovered about the time that Davy was beginning to prosecute his interesting chemical researches, very soon attracted his attention, and from experiments which he made upon this body discovered by Scheele he soon found that the view of it then held by chemists was perfectly untenable; that, in fact, it had as good a claim to be considered an elementary substance as oxygen, hydrogen, nitrogen, carbon, or other elements known at that time. He proposed for it the name "chlorine," from a Greek word signifying greenish colour, that being the colour of the gas. Here is some of it in this vessel. This view of Davy, or, we should say, this fact, which Davy proved by experiment, that the body could not be decomposed—that constituting our definition of an element—was not generally received, and Davy's view of chlorine was for a long time contended against. I remember myself the time when it was not considered particularly unorthodox for chemists still to look upon this substance as an oxide of muriatic acid.

This element, chlorine, which is in many respects a very interesting counterpart of oxygen, although differing in other respects widely from that element, may be obtained by several processes, but may be best procured by the one to which I shall confine myself. This process consists, in fact, in the identical operation by which Scheele first prepared this gas. It consists in placing the binoxide of manganese, containing one equivalent of manganese and two equivalents of oxygen, in contact with hydrochloric acid which is prepared largely for manufacturing purposes, and which is therefore readily obtainable. The solution of that acid is the liquid which we have in this bottle. If we mix together these two substances and apply heat to them, this gas, chlorine, is evolved at once in large quantities; and the mode in which it is evolved, and which was first rendered clear by Davy, will be made evident to you by these cubes. Here is our muriatic or hydrochloric acid; we will take two atoms of it; we shall then consequently have two equivalents of hydrogen and two equivalents of chlorine. That is one of the substances. The other substance we use is the binoxide of manganese, containing one equivalent of the element manganese and two equivalents of oxygen. These bodies placed in contact with each other act in this way: the two equivalents of oxygen combined with the manganese take out from the hydrochloric acid the two equivalents of hydrogen contained in those two atoms of the acid. They come out, therefore, thus [pairing off the cubes representing the hydrogen with the cubes representing the oxygen]. There is one atom of the new compound,—there is the other. Now, what is this that we bring out? Hydrogen and oxygen in equal proportions—equal equivalents: this is, obviously, water. We thus have two equivalents of water separated by this reaction; and one equivalent of manganese and two equivalents of chlorine are left. These two equivalents of chlorine cannot remain combined with the manganese, if the temperature be slightly elevated, that is to about 80 or 90 degrees Fah.; and the result

of the decomposition which may be regarded as taking place simultaneously with the separation of these two atoms of water is, that one of the equivalents of chlorine combines with one equivalent of manganese, forming the metallic salt, chloride of manganese, which remains dissolved in the water; and then we have one equivalent of free chlorine left. This was the re-action which Davy demonstrated to take place in this process of mixing hydrochloric acid with binoxide of manganese, and exposing the mixture to a gentle heat.

Now, this element—chlorine—is remarkable, in the first place, for the great intensity of its affinities. It is difficult to say whether oxygen or chlorine possesses the most powerful affinity for other substances. There is a sort of contention for the mastery between these two elements. Sometimes we have chlorine expelling oxygen, from its combinations, and we have sometimes oxygen expelling chlorine. We may say that the affinities of the two bodies are very nearly equal, but there is just this peculiarity about chlorine, that its affinities are generally capable of being exerted at ordinary temperatures. We have found that oxygen requires usually the application of an elevated temperature to bring its affinities into play. When we wish oxygen to combine with hydrogen, for instance, we have to apply heat to the mixture in order to bring about that combination; but chlorine, on the other hand, is capable, in a great majority of cases, of combining with other substances at ordinary temperatures.

On account, first of all, of its very powerful affinities, and, secondly, of its property of combining with other bodies at ordinary temperatures, chlorine never exists free in Nature; we never can find a trace of chlorine in a free state naturally. It exists, in fact, almost entirely in one form of combination, namely, in this form—a form in which all of us know it very well—as common salt, or chloride of sodium, of which this is a native specimen [exhibiting a piece of rock salt]. The great bulk of this material exists chiefly, as you are aware, in the waters of the ocean. Considerable portions of it have, however, been deposited in the bowels of the earth by the evaporation of inland seas, possibly, or by some other geological process. We make borings, and send down water which absorbs the salt, then pump up the solution and evaporate it, and thus we obtain our supply of chloride of sodium. This natural compound of chlorine contains one equivalent of sodium and one of chlorine. In addition to this compound, we meet with it, though in much smaller quantities, united with potassium, with calcium, with mercury, and occasionally, though very rarely, with silver. The three chief compounds of chlorine which we meet with are those with sodium, potassium, and calcium; and if you look towards our list of elements you will find that these bodies belong to the metals, or to the most positive of our positive elements, whilst chlorine is one of the most negative of our negative elements. The consequence is, that the chlorine which exists in this chloride of sodium is retained there by a very strong affinity, and this metal most effectually neutralises the negative energy of the chlorine. I will not prepare any of this gas before you, because its preparation is always attended with the escape of some of it into the room, and being an exceedingly irritating gas, it would be very unpleasant to prepare it here. I have, however, several jars of it already prepared, and in collecting it it is necessary either to receive it over warm water, or to collect it by the process of displacement. We cannot collect it over mercury, because it immediately combines with the mercury at ordinary temperatures. There again you see it differs from oxygen, which does not combine with mercury at ordinary temperatures. Cold water also absorbs from two to three times its own volume of this gas, and, therefore, there is a considerable loss if we collect it over cold water.

Chlorine possesses the following properties:—In addition to the colour, to which I have already directed your attention, it has a powerful and exceedingly irritating odour. I dare say most of you know this odour. It is the odour that you perceive to issue from that disinfecting substance called chloride of lime, when it is exposed to the air. In that case you have it in a very mild form indeed. The quantity which is given out to the air from the chloride of lime is very slight, but if you attempt to inhale it in the concentrated form, the irritation to the air-passages of the lungs is perfectly unbearable, and in a concentrated form a couple of cubic inches is quite sufficient to deprive a man of life, if it gain access in its undiluted form to his lungs. The specific gravity of this gas is about two and a-half times that of the atmosphere, and therefore we can collect it in such tall vessels as these without much difficulty. It is one of the gases, also capable of being liquefied. It requires the pressure of only four atmospheres to liquefy it, and then it condenses into a yellowish, mobile liquid, the properties of which were first investigated by Mr. Faraday. It is, as I have said, distinguished for its intense negative energy, and for its power of combining with positive elements with great energy. But it is very peculiar—in its taste, I was almost going to say—but at all events in its selection of elements to combine with, it differs considerably from oxygen.

In the first place, as we have already noticed, its affinities are capable of being exerted at ordinary temperatures. Here we have a jar of it, and into this jar I will dust a little powdered metal, and in order that you may not be annoyed with the odour of the gas more than can possibly be avoided, we will perform the experiment under the ventilator. Here I have in this little gauze bag some metallic antimony, reduced to a fine powder, and when we shake it over the mouth of the jar, and cause the powdered metal to fall into the chlorine, you see, the moment it comes in contact with the gas, it ignites, and the two combine, forming chloride of antimony. We may repeat this experiment with powdered arsenic, and several other metals. We may also ignite sodium or potassium in this gas, for those metals are capable of burning in chlorine with very great brilliancy; but I think we had better dispense with any further experiments of this sort, as they might give us too large a quantity of chlorine in the atmosphere. Some of the non-metallic positive bodies—phosphorus, for instance—are also peculiar for possessing powerful affinities for chlorine, and if we introduce a piece of phosphorus into a jar of this chlorine gas, it at once takes fire, and continues its combustion. It is not necessary to ignite it before introducing it into the gas, as in the case of oxygen.

In making this experiment with phosphorus, I wish you also to notice some facts with regard to the light of the combustion, for it is a very instructive experiment. In burning in chlorine gas, phosphorus produces a volatile substance, the chloride of phosphorus, furnishing no solid particles from which the light can radiate, as it does in ordinary gas flames, or flames generally luminous. Now, I will first plunge the phosphorus into the jar of chlorine; it will ignite spontaneously, and you will see that it will burn with a very dim light, scarcely perceptible, I should imagine, at a distance. I will then bring the phosphorus out into the atmosphere, and then it will burn at the expense of oxygen, and form a solid, non-volatile body—phosphoric acid and the phosphorus on emerging from the chlorine, will emit a very considerable amount of light. But the amount of light thus emitted, depends very much upon the temperature of the combustion, and, therefore, if we transfer our phosphorus from the atmosphere into a jar of oxygen, we shall then see the difference of luminosity which occurs in that case simply by an increase in the temperature, because in the air we have the same product, namely, phosphoric acid formed in the same quantity; but in the jar of oxygen you have not the effect of atmospheric nitrogen to diminish the heat and consequently the light evolved by the flame.

There is our piece of phosphorus, and it at once ignites when it comes into the chlorine, and you see with what a very minute amount of light it burns there. Now, we will bring it into the air, and you see the very much greater luminous effect it produces here; and lastly we will plunge it into the oxygen, when the light becomes almost too intense for the eye to bear. The only difference between the combustion in air and in oxygen being the great elevation of temperature which takes place when combustion occurs in the latter.

Chlorine possesses some peculiarities in its tastes, so to speak, for combination. It unites with hydrogen and with the metals, with very great energy, but it is incapable of uniting directly with carbon. At any temperature to which we like to expose the two elements, they will not unite. Carbon, you will recollect, burns in oxygen at an elevated temperature with very great energy indeed, and we have some forms of carbon which take fire in atmospheric air without any application of heat whatever, but you cannot by any such direct process induce carbon to combine with chlorine.

This renders the action of chlorine on any ordinary combustible very peculiar. If we plunge a taper, for instance, into a jar of this gas, the taper will continue to burn for a few moments, but it is very soon extinguished. The taper at present burns with its ordinary luminous flame. Now we will plunge it into this jar of chlorine, and you see what an immense amount of smoke it produces, and how dimly it burns, and I think we shall find presently that it will be extinguished. It is now extinguished. It is incapable of continuing its combustion in the chlorine for this reason—the chlorine is only capable of uniting with the hydrogen of the combustible, and it separates the carbon of the wax taper. The smoke that was given off from the flame was due to the separation from the wick of the particles of carbon which are totally consumed while the taper is burning at the expense of oxygen. These particles of carbon gradually choke up the pores of the wick, and prevent the ascent of the wax to the summit of the wick where it would be consumed, and therefore the taper after a short time is extinguished. A gas light is capable of burning in chlorine for any length of time. It burns with a smoky flame, but it contains so much more hydrogen than the candle-flame, whilst it has no wick to become choked, that it is capable of continuing its combustion. There is another experiment illustrative of the same thing. Camphine is essentially a compound of hydrogen and carbon, like the wax of the taper, and if we spread it over a large surface of paper we see very strikingly the relative affinities of the chlorine for the hydrogen and for the carbon. We shall find, I think, if our turpentine is sufficiently pure, that it will be spontaneously ignited by the chlorine; the chlorine will attack the hydrogen of the turpentine, and the whole of the carbon will be deposited in a dense cloud of smoke as in the case of the combustion of the taper. I will pour a few drops of this camphine upon paper and then plunge it into this jar; you see we have it spontaneously ignited and the carbon separated from it as a dense fuliginous cloud, which in fact has covered the interior of the vessel with a mass of carbon, rendering it perfectly black. This is one of the peculiarities, then, of chlorine—its powerful affinity for hydrogen and its almost total want of affinity for carbon. It is true that we can get compounds of carbon and chlorine, but we can only get them by indirect means. This is effected by first combining carbon with some other element, and then removing that element by means of chlorine; we cannot make them unite directly in this process of combustion.

Another of the peculiarities of chlorine, serving to distinguish it from oxygen, is the effect of light upon its affinities; in fact light is to chlorine, in a great measure, what heat is to oxygen. We have seen that the application of heat to mixtures of oxygen with combustible elements, as hydrogen, for instance, is capable of causing those elements to combine. In the same way the application of light in some cases to mixtures of chlorine with similar elements causes them to combine. I will endeavour to render this visible by an experiment which I intend to make here: it is an experiment which requires a good many precautions to make it succeed, and as I have not had an opportunity of trying it before the lecture, I cannot promise you success. What I am going to do is this,—I am going to mix together hydrogen with chlorine in one of our collodion balloons. These two gases are produced by the electrolysis of muriatic acid, which is torn asunder in the same way as water, and we have its two elements, chlorine and hydrogen, evolved in equal volumes. If we then connect our balloon here with the exit tube of this decomposing apparatus, we shall be able, I trust, in this way, to fill it with the mixed gases. [The collodion balloon was attached to the decomposing apparatus and the room was darkened.] We shall soon have filled that balloon with the mixed gases; and you see we are doing it with the exclusion of daylight, because that would cause the gases to ignite or combine, and defeat our experiment. We have here two parabolic reflectors—copper reflectors, silvered. We shall produce the electric light in the focus of the lower one, and as soon as our balloon gets near the upper one, the effect of the lower one will be to collect and gather up all the rays given off from the coal points which we shall here ignite, and to send them as a solid cylinder of rays, so to speak, against the upper reflector, and the upper reflector will receive this cylinder of rays, and will concentrate them to a point at some five or six inches lower than the level of the upper reflector; and thus we shall have our balloon exposed to this intense light so concentrated. We will just try our mirrors, and ascertain if we are likely to get a sufficient amount of light upon the balloon to effect the experiment. Whilst the balloon is filling, I will show you the corresponding experiment with the mixed oxygen and hydrogen gases which we will cause to explode by heat, just as we hope to make the mixed hydrogen and chlorine explode by light. For this purpose we will inflate another balloon with these mixed gases. [A collodion balloon similar to the one being inflated with the hydrogen and chlorine was attached to the vessel containing the mixed hydrogen and oxygen.] Now, you see, our second balloon is inflated, and I think it will possess a sufficient ascending power to reach the top of the theatre, and we will set light to it by means of a little bit of thread impregnated with nitre, which will act as a fuse; and when that fuse burns so as to come in contact with the collodion balloon, it will ignite the envelope, and will communicate a sufficient amount of heat to the mixed gases to cause the mixture to explode. [The balloon ascended to the top of the theatre, and a light having been previously applied to the thread, the latter burnt away until the fire reached the balloon and exploded the gases.] There, you see, is the result; the two gases ignite; and now I hope to produce a similar effect with the chlorine and the hydrogen by the agency of light. I think we may, perhaps, have a sufficient quantity here for our purpose. We will at once bring our balloon up to its proper position, and you will see the result. [The balloon was brought into focus, and immediately exploded.] You see, our two gases by the action of light produce just the same result as we produced in the other case by the action of heat; the moment the two coal-points were separated that concentrated light fell on the balloon, and produced this effect, which is not due to heat, as you see the envelope of the balloon is still unconsumed. Thus light is to chlorine to a certain extent what heat is to oxygen.

We have the same intense affinity of chlorine for hydrogen coming strikingly into play also in the processes of bleaching and disinfecting by chlorine, for chlorine is one

of our most powerful disinfectants. I will now endeavour to show you the mode of bleaching by means of this agent, chlorine. For this purpose we will use a solution of the gas. Here we have a cylinder full of a decoction of cochineal, which possesses intense colour. To this we will add some of the chlorine-water, and you see where it descends how the colour disappears. I do not know whether we have added quite sufficient, but probably we have enough to destroy the whole of the colour contained in that cylinder. You see the colour is gone under the action of the chlorine. Now, the action of the chlorine in destroying colour is the same as in the disinfection of noxious compounds. It consists in the removing, more or less completely—in the one case from the coloured compound, and in the other case from the noxious compounds which we wish to render innocuous—the hydrogen which those compounds contain. Let me try to illustrate this by some of our blocks. We will collect together here some atoms of chlorine; and here we will form a hypothetical miasmatic atom if you please which shall consist of nitrogen, carbon, hydrogen, and oxygen. This we may regard, then, as a hypothetical miasmatic atom, containing carbon, nitrogen, hydrogen, and oxygen. Such an atom is gradually undergoing oxidation; the hydrogen is gradually removed by atmospheric oxygen and replaced by the latter element. So long as this goes on, so long does this atom retain its noxious property. Before the process begins, it is innocuous; when it is completed, it is again innocuous. It is only while it is going on that noxious effects are to be apprehended. Now, the action of chlorine upon such a substance is to complete at once this process of removing the hydrogen from the atom. I will show the mode in which the hydrogen is removed. Two atoms of chlorine are required for the removal of each atom of hydrogen from this infectious matter. It is done in this way. One of these atoms of chlorine takes out an atom of hydrogen, brings it out in the form of hydrochloric acid, and the other atom of chlorine goes into the place of the hydrogen; so that you see now we have a body containing one equivalent less of hydrogen than we had before, and that hydrogen is replaced by chlorine. If this operation be repeated, we shall then remove the whole of the hydrogen from this noxious substance, and we shall then have replaced the whole of this by chlorine. The substance is no longer spontaneously oxidisable, and is deprived of its power of burning or slowly oxidising in atmospheric air. Its hydrogen is completely removed by the chlorine, and its noxious qualities are destroyed, it being no longer capable of undergoing oxidation, or of producing noxious effects.

The action of light upon chlorine, in producing compounds of that element, leads us naturally to speak, in the first place, of the action of light generally upon chemical affinity. This influence is far more restricted than the influence of heat upon the chemical force; nevertheless, the cases in which it occurs are of very great importance, and very considerable interest. For instance, that operation to which I alluded in the last Lecture,—the operation by which plants are capable of removing from the air carbonic acid thrown into the atmosphere by combustion and respiration, and returning to the air the oxygen contained in that carbonic acid,—can only take place in the presence of light; it cannot be carried on without luminous influence. This, then, is an instance of a grand modification of chemical affinity which is taking place all around us, and on which, in fact, life almost entirely depends. Of this process we may say we know simply nothing, for we have not the slightest idea how, by the action of light, the leaves of plants are capable of decomposing carbonic acid; we cannot imitate it in any of our processes; we can only effect it by the agency of our most powerful affinities. In addition to this grand operation of light in modifying chemical affinity, we have several others which are of considerable importance. We have this effect upon the affinities of chlorine, bromine, iodine, and silver; these are the chief elements, in fact, on the affinities of which light is capable of exerting an influence; and if I may be permitted at all to generalise upon this influence, I should say that in the case of chlorine the affinities of that element are almost invariably increased by the action of light. The affinity of bromine is little affected; that of iodine and of silver is greatly depressed under the influence of light, so that a compound which iodine would be capable of forming in the dark it would not be capable of forming in the light; whilst a substance which chlorine would be incapable of forming in the dark it could produce under the influence of light. Now, the different rays of which white light is composed, do not all of them exercise this influence upon affinity, it is only one class, or one set, of those rays, the most refrangible of them, those that are capable of being most turned out of their course by passing from one medium to another, it is only these most refrangible rays that are capable of exerting this influence. I will endeavour to show you upon this screen the rays to which I refer, and we will endeavour then to get some chemical effect from those rays. [The room was darkened, and the prismatic spectrum thrown upon the screen.] There you have what is already well known to you, namely, the spectrum of the electric light—a beautiful series of colours, beginning at one extremity with red, then orange, then a band of yellow, then of green, then a band of blue, and finally, a band of indigo, but it is only the rays at this blue extremity of the spectrum that exert this chemical action; in fact, we may say that the rays at the other extremity rather neutralize what has been done by the rays at the blue extremity. These so-called "chemical rays," are invisible to the human eye; possibly, they cannot penetrate to the retina; at all events they are incapable of giving us the sensation of light when they reach it, supposing they do arrive there. Now, I will endeavour to make these rays visible to you by a process for which we are indebted to Professor Stokes. I have here a piece of uranium glass. You see this glass becomes luminous in the invisible rays of the spectrum beyond the blue. A piece of paper covered with sulphate of quinine will give us a somewhat similar result. That paper is illuminated in the dark portion of the spectrum, and these are the very rays which affect chemical affinity to the greatest extent. We will now interrupt this spectrum, or intercept it on its way to the screen by a photographic plate, by means of which, I think I shall be able to obtain an image of the spectrum, and to show you the way in which these rays modify chemical affinity. We will first get our image upon a sheet of ground glass, and in such a position as will enable us to receive it upon a glass plate prepared with collodion. There we have a tolerably sharp representation of the orange, the yellow, the green, the blue, and the indigo; and now the chemical effect will only begin at the line where you see the luminous spectrum ends, while the other or visible part will produce little or no chemical effect in the operation we are now going to perform. Here I have a sheet of glass upon which I will spread a film of iodised collodion—collodion containing iodide of potassium, and we will now immerse this plate in a solution of nitrate of silver, so as to precipitate by the ordinary photographic process, in fact—the so-called collodion process—a film of iodide of silver upon the surface of the plate. That will be precipitated in one or two moments, and then we will expose that film to the action of the spectrum, which we have before obtained on the ground glass. We will remove the ground glass, and substitute for it our prepared plate. Here, you see, we have a yellow film of iodide of silver produced upon that plate. It is necessary first to secure the complete evaporation of the ether in which the collodion was dissolved; that, I think, we have now sufficiently effected, and you see we have a yellow film here. I do not want to expose it too much

even to the light of this gas, but some of you may, perhaps, wonder why I am operating here with this comparatively brilliant light. The fact is, that this gas-light contains very few of those rays which I rendered visible to you on the spectrum, and, consequently, it is incapable of producing any effect on this plate, and I may work with this gas flame for a short time, at all events, with impunity. Now we will expose the plate to the spectrum. I will make a mark here where the luminous spectrum goes to. It is a very rough mark, but it will do for our purpose. I have just marked the extent upon the plate to which the luminous part of the image of the spectrum comes, so that you may be able to judge when we throw the image of this plate upon the screen, after we have brought out our effect, whether what I have said be correct or not, as to these chemical rays existing upon the outside of the spectrum. The spectrum has now acted sufficiently, and I pour upon this plate what photographers term a "developing solution," which is a solution of pyrogallic acid. This enables the surface of the iodide of silver, where it has been exposed to the light, to decompose the nitrate of silver in the presence of this pyrogallic acid, and to produce an image on the plate. You see we have here an image of our spectrum. Now, I will remove the sensitive coating from the plate by means of a solution of cyanide of potassium, so as to make it more transparent in those portions which have not been acted upon by the light. Having thus got our effect, let us examine in what direction that effect has been produced, whether it has been produced, or much of it produced by those luminous rays, or whether we have been indebted chiefly to the non-luminous portion of the spectrum. I will try to throw an image of our result upon the screen by means of this lens; and now we will interpose our plate, and there is the result we have got. You see a great chemical effect has been produced on the right hand of that little notch which I cut with a strip of wood on the plate while the photographic process was going on. That line marked the extent of the visible spectrum. To the right all is invisible on the plate, and in that part we had the visible spectrum on the screen. You see to what extent in that direction the chemical effect has gone, and how very much more the rays have operated to the right than to the left of it.

I shall now be able only to glance very briefly indeed at the compounds of chlorine. We have the names and composition of these compounds upon these diagrams:—

Compounds of Chlorine.

I. With Hydrogen.	
Hydrochloric Acid . . .	HCl
II. With Metals.	
Protochlorides	MCl
Sesqui-chlorides	M_2Cl_3
Bichlorides	MCl_2
Terchlorides	MCl_3
III. With Oxygen.	
Hypochlorous Acid . . .	ClO
Chlorous Acid	ClO_3
Peroxide of Chlorine . . .	ClO_4
Chloric Acid	ClO_5
Perchloric Acid	ClO_7

Chlorine forms only one compound with hydrogen—hydrochloric acid,—from which Scheele first obtained this element. This compound, as I remarked before, was at that time called muriatic acid. With metals it forms four principal kinds of compounds, namely, first the compound in which one equivalent of metal is united with one equivalent of chlorine, these are called protochlorides; secondly, sesquichlorides, or bodies containing three equivalents of chlorine to two of metal; thirdly, bi-chlorides, or bodies containing one equivalent of metal and two of chlorine; and, lastly, ter-chlorides, or bodies containing one equivalent of metal and three of chlorine. Then we come to the compounds of chlorine with oxygen. These are exceedingly curious bodies, and if time had permitted, I would have shown you specimens of one or two of them and their reactions; but it is impossible that we can do that now. It is very singular that these two elements, which are so much alike in their chemical characters, should combine at all. They are the two most negative elements with which we are acquainted, and yet you see they form this numerous class of compounds. It may, in fact, always be regarded as a rule in chemistry, that, if two elements will unite, then the nearer their affinities, or, rather, the nearer their chemical qualities come together, the more numerous will their compounds be, but, at the same time, such compounds will be very unstable. The two elements now in question form some of the most dangerously explosive compounds with which chemists are acquainted, and it is very difficult to prepare some of them, even in small quantities, without fear of explosion. On the other hand, the compounds of chlorine with metals, and with the positive elements, are characterized by great stability, and if we have in the compounds one equivalent of metal united with one equivalent of chlorine, they are invariably all of a neutral character.

Some of the general considerations regarding this subject I have marked among the following memoranda, to which I can now do no more than refer you:—

1. Chlorine always occurs in Nature combined with positive elements, and chiefly with sodium, as common salt.

2. Chlorine is distinguished for its intense negative energy, and for its capability of exerting its affinity generally at ordinary temperatures.

3. It possesses a very feeble affinity for carbon.

4. Light frequently affects the affinities of chlorine, in the same manner as heat influences those of oxygen.

5. Chlorine exerts great bleaching and disinfecting powers. Its affinity for hydrogen endows chlorine with both these powers.

6. Oxygen, hydrogen, nitrogen, carbon, and chlorine may be considered as the chemical representatives of all the other elements; thus sulphur, selenium, and tellurium are closely allied with oxygen in their chemical habits. Most of the metals bear a strong chemical resemblance to hydrogen. Phosphorus, arsenic, and antimony are closely analogous to nitrogen. Boron and silicon possess considerable likeness to carbon; whilst bromine, iodine, and fluorine are the chemical counterparts of chlorine.

In conclusion, I have very briefly to direct your attention to the remaining elements which belong essentially to inorganic chemistry, and I trust that none of my audience have expected that I intended in these Lectures to give the history of the whole of these elements; it would have been utterly impossible in such a Course of Lectures. I have endeavoured rather to take representative elements, and make these illustrate the action of the chemical force—representatives symbolising the action of corresponding elements in a vast number of instances.

I have treated of oxygen, hydrogen, nitrogen, carbon, and chlorine, as representatives of five great classes of elements. Under these five elements you may group together all the other elements, and you may regard the reactions which we have seen to ensue with these elements as going through their respective groups, to a very great extent at all events. There are, of course, peculiarities in the case of each element; but the general characters of the reactions of these representative elements may be regarded as going through the entire of the five classes at the head of which they are placed.

Vulcanised India-rubber which is worn out, until it has become as brown as the pure caoutchouc, still contains an appreciable quantity of sulphur.—*Dr. L. C. Levoir.*

NOTICES OF PATENTS.

An Improved Grease for Lubricating the Frictional Surfaces of Machinery. C. N. Leroy. Paris.

This lubricating composition is prepared from oil or fatty matters mixed with small quantities of the alkalies, potash and soda, in aqueous solution. The inventor recommends that the materials should be employed in the following proportions:—Of any serviceable description of lubricating oil take 33 parts, tallow 25 parts, caustic soda or potash mixed in equal proportion 2½ parts, dissolved in about 40 parts of water. These ingredients require to be well incorporated by kneading, when they will furnish a very white soft grease, suitable for lubricating the bearings and other moving parts of machinery without having any tendency to corrode the metallic surfaces.

The mixture of materials here specified would result in the preparation of a very crude and partially saponified soft soap. Some alkali would doubtless remain for a considerable time in the free state, and, although this may not exert any deleterious action upon surfaces of iron, there would be every probability of its acting injuriously upon brass, bronze, and some of the softer alloys occasionally used for the bearings of machinery. The want of definite instructions regarding the kind of lubricating oil to be employed with the tallow renders it impossible to define more exactly the chemical nature of the ultimate product. Whether olive oil be used, or any one of the class of mineral products obtained in the distillation of shale or coal, such as paraffin oil, either would equally answer to the term "lubricant;" but inasmuch as these oils differ widely in their behaviour with caustic alkalies, the first only being capable of saponification, the lubricating material would possess different properties accordingly as one oil or the other happen to have been employed in its preparation. Both soft and hard soap dissolved in water, and the same incorporated with various kinds of grease, have received in this country a wide application for lubricating purposes.

MISCELLANEOUS.

Stoppers of Caustic Solution Bottles.—It is well known that the stoppers of these bottles rapidly become incrusted; greasing is of little use, moreover, we have to consider that we may thus introduce fatty acids into the solution; now paraffine answers well: first, because caustic alkali does not act upon it, and secondly, because it perfectly lubricates the surfaces in contact.—*Polyt. Notizblatt.*

A Sensitive Reagent for Sulphur.—By M. Schlossberger.—A solution of molybdate of ammonia in hydrochloric acid diluted with water, possesses the property of colouring blue, if traces of sulphur are present. By this means the presence of sulphur even in a single hair is easily recognisable.—*Polyt. Notizblatt.*

Nitrate of Soda.—Nitrate of Soda in the neighbourhood of the River San Francisco, Bahia, Brazil:—I have the honour to acknowledge the receipt of your lordship's despatch of January 7 last, instructing me to report, after a careful inquiry, on the localities in which nitrate of soda has been found in this province, its state of purity, the cost of extracting and refining it, and the expense of transport to a shipping port. In reply I beg to state that ever since the mention made in my Commercial Report for the year 1856 of the discovery of this important manure in this province I have received undoubted information of its existence in several other localities, and in consequence lost no time in renewing my exertions, with the assistance of a few friends having connexions in the interior, to obtain every information possible thereon. The information received from several districts is such as to satisfy my most sanguine expectations, especially in the north-east of this province, in the neighbourhood of the River St. Francisco, at a place called "Salitre." In the words of a most distinguished and talented native of the town of Joazeiro, through a valley of sixteen to twenty leagues long, one mass of nitrate of soda is found; in some places on the surface, at others a few feet under; and it contains sufficient manure for exportation for years to come. On the opposite side of the above-named river, near the town of Pilao-Arcado, other deposits exist in equal quantities. The projected Bahia railroad to the town of Joazeiro must pass through the first named district, but those magnificent deposits will only become available when that railroad reaches the St. Francisco. In the interest of the Company and of commerce it is ardently to be desired that its works should be commenced and prosecuted with vigour, as the distance is only 240 miles from the city.—*Extract from the Report of H. B. M. Consul.*

New Process for Preparing Nitrate of Silver.—By M. Greiner.—Dissolve impure silver in nitric acid, and when the liquid is almost neutral and cold, add a solution of sulphate of soda to precipitate the sulphate of silver, which is to be washed in distilled water; after this digest it with heat, with a proper proportion of nitrate of baryta, thus forming sulphate of baryta, to be separated by filtering, and nitrate of silver which can then be crystallised. It remains to be seen whether the product is pure; the facility with which nitrate of silver combines with alkaline nitrates, makes it likely that it would also have a certain affinity for nitrate of baryta.—*Journal de Pharmacie et de Chimie.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

C. Eades.—The fault is not in the cyanide solution, but in the way the iron has been cleaned. After it was removed from the "pickle" it should have been soaked in strong soda, and after being washed, instantly dipped into the cyanide solution. When the copper is properly precipitated it should be again well washed. You can get all the apparatus necessary for the electric light and experiments with vacuum tubes at Mr. Ladd's, Beak Street, Regent Street.

D. Clifton.—The subject is rather an intricate one. If we meet with any good information, it shall at once be published. We are obliged for the information and will endeavour to learn further particulars.

Riflemen's Belts.—To polish enamelled leather, take half a pint of the best cream, a quarter of a pint of linseed oil, make them each lukewarm, and then mix them well together. Having previously cleaned the leather, rub it over with a sponge dipped in the mixture; then rub it with a soft dry cloth until a brilliant polish is produced.

A Reader.—We have seen nitro-benzol prepared almost colourless by distilling it by means of steam at a temperature below its boiling point. Distillation in the ordinary way is apt to injure the delicacy of its odour.

Ice.—A correspondent writes:—"A friend of mine in the West Indies having lately seen a paragraph, evidently taken from a Paris paper, of a French gentleman who experimented before the Society of Arts with two quicksilver batteries, and having put one of them in the fire, after pouring in ammonia, made ice. My correspondent having bought the utensils, is unable to work them, and has therefore requested me to ask your advice and assistance."

Chemistry of Brewing.—Preventing Beer from turning Sour.—We have the following from reliable authority:—A French chemist has discovered a chemical compound, by which, upon the addition of a quantity of it, according to the quantity of beer operated upon, it prevents the beer passing into the acetous fermentation, and keeps it in a perfectly sound condition for an almost indefinite space of time, no matter the quality of the materials used in its manufacture; but as beer, &c., are excisable articles and the penalties heavy if found adding any substance otherwise than allowed, the discoverer goes to the Board of Inland Revenue, states the discovery he has made, wishes to know if any brewers using it would be prosecuted. The Board reply by saying it must receive a searching analysis by their chemists, to see whether it would be injurious to the consumers. In a subsequent communication from the Board, a reply is given that it possesses no injurious properties, and he is allowed permission to use it. He is about getting a patent for it, as to have used it without the sanction of the Board, prior to obtaining a patent, would have subjected him to heavy penalties.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. MULDER,[1] *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chêne; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

IN the latter part of the reign of King Charles X., the celebrated Gay Lussac made a proposition to introduce a different method for the estimation of silver. It had been proved that the method by cupellation gave, even in the hands of very able practical men, not always the same and satisfactory results; and further, it had also been proved, that this method was liable to faults against which it seemed there were no means of guarding. The new method adopted was the volumetrical one. A weighed quantity of the silver to be assayed for its real value is dissolved in nitric acid; another weighed portion of perfectly pure silver is also dissolved in the same acid. A solution of common salt in water is made so as to be of known strength, and so much of this solution of common salt in water is added to both solutions of silver in nitric acid, as is necessary to precipitate all the silver in each of the solutions.

Since common salt undergoes double decomposition in contact with nitrate of silver in such a manner, that nitrate of soda and insoluble chloride of silver are formed, and since common salt precipitates silver always in equivalent proportions, the quantity of the solution of common salt which has been used, can serve as a measure for the quantity of silver in the solution of silver which has been subjected to analysis. In the same way, the solution of pure silver gives the value of the measure, with which the silver to be analysed is to be compared. If, for instance, one gramme of the pure silver had been weighed, and also one gramme of the silver to be analysed, and if of the very same solution of common salt 1000 parts by liquid measure had been necessary to precipitate all the pure silver, and 900 parts only of that solution had been applied to precipitate perfectly the silver subjected to analysis, then the value of the silver to be analysed should be to the value of the pure silver as 900 to 1000. This most excellent method was not only highly satisfactory to its inventor Gay Lussac, but proved to be the same to every one who became acquainted with it. It was very soon adopted by every one who appreciated correctness, and it soon superseded the method by cupellation. Gay Lussac wrote a memoir, in which he gave a description of his method as it is yet employed, under the title, "Instruction sur l'Essai des Matières d'Argent par la voie Humide; Paris: 1832;" which memoir was translated into German by Liebig, under the title, "Vollständiger Unterricht über das Verfahren, Silber auf nassem Wege zu Probiren; Braunschweig: 1833." It is a most extraordinary proof of the perfectness of this method, which is called the assay by the moist way, that after so many years it has not been changed. It still remains as a monument erected by the practical genius of Gay Lussac.

It may give rise to some astonishment that this method has not been repeatedly subjected to scientific researches, and the results published, were it only for the reason that this method, after having been invented, has come into general practice. In the first place, it must be stated, that the science of Chemistry has been greatly advanced, and although, on the other hand, Gay Lussac himself has published his method, perfectly fit for general use, a great many scientific points relating to it have neither been explained nor touched by him. No doubt the skilful men who in their practice have nearly daily to do with the so-called method by the moist way, have made a valuable collection of many points relating to this method, but none of these has been published; in every manual the general foundations of the practice of this method have been given, but nothing more. Notwithstanding this, it is in this, as in so many other parts of science, there will always be found something valuable when a thoroughly deep investigation is made, and the facts viewed under a somewhat changed light.

I therefore hope, that no one will charge me with temerity, when I, when other more capable men in the use of the method by the moist way keep silent, undertake to investigate that method chemically, and to explain the particulars to be observed in it, and to try according to the best of my capability to review this method by the moist way in the light of the modern science of Chemistry.

I am aware that I am hardly competent to treat the subject according to its value, all be it that my honoured friend, Mr. Van Riemsdyk,[2] has shown me his method of operating. Part of the experiments mentioned hereafter have been done by me, with the assistance of Mr. Van Vlaanderen.

Although I do not intend to make remarks, neither to give explanation, about all things relating to the method, I have thought it expedient to review it both in a practical and scientific point of view.

As far as the practical application is concerned, I wish to give all that has appeared to me necessary to increased exactness, as well as facility, I have altered the apparatus according to my own experience, and I will

[1] Translated from the original Dutch by A. Adriani, Math. Mag Phil. Nat. Medicæ Doctor, Fellow of the Royal Netherlands Institution of Engineers, &c., &c.

[2] A. W. G. Van Riemsdyk, Esq., is a Member of the Supreme Council of the Mint of the Kingdom of the Netherlands,—by the bye, one of the most extensive mint works of Europe, established at Utrecht.

give the reasons for the changes made. I shall be able to prove that my apparatus give correct results, and their simplicity is such that they may be readily constructed from the materials found in every well-arranged chemical laboratory.

The only instrument which must be procured from elsewhere is a balance, and it is just this instrument which is an impediment to reaching absolute accuracy, even when one is in the possession of a balance which is sensible to the one-twentieth part of a milligramme. As far as the method itself is concerned, it is able without any difficulty to estimate the silver to one-twentieth of a milligramme for one gramme of silver.

I divide my research into two parts,—*The Chemical Investigation*, and *The Practical Method*,—and may state at once that by what is called normal solution of common salt, I mean such a solution of that salt in water, that 100 cubic centimètres of it contain at a temperature of 15° C., 0·54141 gramme salt, a quantity just sufficient to precipitate a solution of 1 gramme of pure silver dissolved in nitric acid. By decimal salt solution I mean one part of the same liquid diluted with nine parts of water. I must also mention that I understand by decimal silver solution a solution of 1 gramme of perfectly pure silver in nitric acid diluted with water to 1 litre, also at a temperature of 15°.

Decimal solution of salt and decimal solution of silver have been applied to the same volume, both being of equal strength. 1 cubic centimètre decimal solution of salt precipitates 1 milligramme of silver, and 1 milligramme of pure silver is contained in 1 cubic centimètre of the decimal silver solution.

I. The Chemical Investigation.

Solid Substances in Liquids.—If we wish to become acquainted with the method by which the quantity of silver is estimated, when a solution of silver in nitric acid is precipitated by a solution of common salt in water, it is necessary, in the first place, that we should make a thorough investigation of that which goes on when dissimilar substances are present together in a liquid.

It is easy to say from chloride of sodium there is formed chloride of silver, while at the same moment nitrate of soda is reproduced from nitrate of silver. The chloride of silver being insoluble is precipitated, while nitrate of soda remains in solution in the liquid. It is scarcely necessary to prove that things are not going on in this case in such a simple way; or to say that such though it is the chief action which takes place, is not the only one which is called into play here.

Beside the action of the real chemical affinity, there are in the action which solids and liquids mutually produce, consecutive actions of the so-called physical influences, which here, as in many other instances, play so prominent a part, that even Berthollet felt inclined to give them a first place while engaged in publishing his celebrated work, "Essai de Statique Chimique, 1803."

These so-called physical influences are certainly to be taken notice of, even although we know them only imperfectly, and although they are neither well classified nor expressed in laws.

Should we take them for these reasons, as if they were not existing, or should we cast them aside as if they had only a minute influence?

Even he who only makes use of chemistry as a branch of applied science is driven by the necessity of the greatest possible correctness to value every influence, though he does not care about the name, whether it be chemical or physical; in the same way he who is a scientific chemist by profession makes use of many parts of the chemistry applied to arts in order to obtain more information, for in applied science an important fact is often hidden from which pure science can derive profit; profit, however, not so much in the sense of making money as in the sense for the promotion of true genuine knowledge.

If a more correct idea be formed of what happens when a solution of silver is precipitated by a solution of common salt, then it will be seen that it gives rise to many peculiarities worthy to be studied more closely; and, even although they cannot yet be explained in all parts, they merit a place along with that of the peculiarities of many other substances in action. It may be, therefore, not altogether unfit to begin our investigation by bringing these under a general point of view, or to show at least the relation which exists between them, and in doing so we are sure to obtain more space for the right representation of the phenomena presented by the precipitation of a silver solution by a solution of common salt. In the first place, then, I will take under consideration the position in which solids are placed when in solution in liquids, dissimilar solid substances of course, which, generally speaking, must be considered to exercise a chemical action upon each other; which, however, are either totally or partly prevented from satisfying their chemical action by the interference of so-called physical influence.

There exist a great many instances in which it can be proved, that the fact of a substance *a*, being in solution, can exercise a great influence upon the mutual affinities of two others, *b* and *c*, which are held in solution by the very same liquid. Vauquelin (*Ann. de Chimie*, tome xii.) gives a very simple instance of such an occurrence. He prepares a saturated solution of a salt *a* in water, and afterwards dissolves in the same solution a salt *b*, after which a fresh quantity of the salt *a* can be dissolved by the previously saturated solution of it. The degree of solubility of the salt *a* first depended upon the action which took place between *a* and water; but by the presence of *b*, *a* is again disposed to enter into the solution to a greater extent than before.

It is supposed in this case that the salts do not act chemically upon each other; hence it follows that two salts which have not a chemical action upon each other, if in solution together in the same liquid, have the power of increasing their mutual solubility, and *a*, as well as *b*, endeavour to do so. Like as there is no limit for the physical division of solids, so there is no solid also which may be called perfectly insoluble, provided it admits of very great divisibility. What we are accustomed to call insoluble in chemistry is not really so. The solubility of sulphate of baryta in water, of oxide of tin (stannic acid), in dilute nitric acid, of carbonate of lime in water free from carbonic acid, can be readily proved. Since water possesses the property of keeping in suspension, or even in solution, a great many minutely-divided substances, and since, according to the instance just mentioned, as given by Vauquelin, the solubility of a soluble salt can be greatly increased by the solution of another quite different salt in the same liquid, then the case may often occur that a so-called insoluble substance in water is rendered perceptibly soluble by the presence of another soluble substance, or in case it would have been otherwise precipitated, can be kept in solution. In such cases the chemical affinity gets modified simply by solution, for the substance which we are acquainted with

as being insoluble remains in solution, and presents itself to us in a quite different aspect from that by which it is ordinarily characterised.

Among the instances of the so-called physical influence upon chemical affinity, I may bring here under notice the mutual action of sulphate of soda and chloride of magnesium: both being dissolved in water it is quite dependent upon the temperature in what form they crystallise. In the cold, sulphate of soda crystallises out, chloride of magnesium remaining in solution; at a higher temperature sulphate of magnesia and common salt are formed, and at the boiling point, again, another change takes place,—separation, viz., of a double salt of sulphate of magnesia and sulphate of soda. It is in this way that Balard obtains sulphate of soda from the brine which yielded common salt, merely by means of cooling. (*Regnault, Cours Elément. de Chimie*, p. 577.)

(To be continued.)

On the Estimation of Tin by Standard Solutions, by M. Scheurer-Kestner, *of Thann.*

The estimation of tin by standard solutions depends on the transformation of protochloride of tin into bichloride. MM. Streng and Mohr[1] have employed bichromate of potassa, solution of iodine, and permanganate of potassa as oxidising agents. The result of M. Mohr's experiments is that whichever of these bodies is employed the proportion found varies with the quantities of water used, that upon taking a certain quantity of chemically pure tin, the trials made with permanganate of potassa, or any other oxydiser, will not give the weight of tin employed, but always a less weight, a circumstance which has induced him to admit for these estimates an empirical atomic weight for tin (65), differing greatly from the actual weight (59). Even this number is allowable only when operating constantly with quantities of water equal to those which served to determine it.

M. Lenssen[2] estimates tin by the iodinine solution, but he operates in a liquid containing double tartrate of potassa and soda, and bicarbonate of soda in excess. The results M. Lenssen obtained by this method are satisfactory, by using the atomic weight of tin generally adopted (59). We shall see further on why M. Lenssen's results agree.

M. Stromeyer[3] having recently occupied himself with the same subject, has succeeded in solving the difficulty. The solution of protochloride of tin is carefully introduced into an excess of sesquichloride of iron. The salt of iron becomes reduced to a minimum according to the following equation:—

$$Sn + 2\,(Fe_2\,Cl_3) = Sn\,Cl_2 + 4\,FeCl.$$

It is then estimated by permanganate, as if it were a salt of protoxide of iron. The results M. Stromeyer obtains in this way are very exact. The author adds that such a method of estimating is applicable only in the absence of copper or iron, as these two metals decompose permanganate of potassa, as well as the tin; but it may be of great use in the estimation of commercial salts of tin.

I have endeavoured to determine the causes of the variations observed when oxidising a solution of protochloride of tin, proximately by permanganate of potassa, and whether, as M. Mohr supposes, these anomalies arise only from the presence of oxygen dissolved in the water. To make these experiments agree better, the solution of protochloride of tin mixed with the proper quantity of water has been instantaneously oxidised by permanganate, so as not to take time into consideration. The irregularities occurring during this operation are shown in the following table:—

	c. c.						— Permanganate.
	2	of	Sn Cl,	without	water,	required	34·5
	2	,,	and	10 c. c.	water	,,	34·5
	2	,,	,,	20	,,	,,	34·5
	2	,,	,,	50	,,	,,	34·5
	2	,,	,,	100	,,	,,	34·0
	2	,,	,,	200	,,	,,	33·0
	2	,,	,,	300	,,	,,	33·0
	2	,,	,,	400	,,	,,	31·0
	2	,,	,,	500	,,	,,	31·0
	2	,,	,,	600	,,	,,	29·0
	2	,,	,,	700	,,	,,	30·0
	2	,,	,,	800	,,	,,	28·5
	2	,,	,,	900	,,	,,	28·0
	2	,,	,,	1,000	,,	,,	28·0
	2	,,	,,	1,200	,,	,,	25·0
	2	,,	,,	1,400	,,	,,	23·0
	2	,,	,,	1,600	,,	,,	22·5
	2	,,	,,	2,000	,,	,,	17·0
	2	,,	,,	3,000	,,	,,	8·0
	2	,,	,,	4,000	,,	,,	10·0
	2	,,	,,	5,000	,,	,,	17·0
	2	,,	,,	6,000	,,	,,	18·0
(A)	2	,,	,,	8,000	,,	,,	24·0
	2	,,	,,	10,000	,,	,,	23·0
	2	,,	,,	14,000	,,	,,	25·0
	2	,,	,,	24,000	,,	,,	32·5
(B)	2	,,	,,	24,000	,,	,,	32·0

Leaving A and B to rest for ten minutes,—

(A) has required 14·0 of permanganate.
(B) ,, 25·0 ,,

The result of these experiments is that the more the solutions are diluted, the less permanganate is necessary until the proportion becomes about 10,000 parts of water to one of tin (100 cubic centimètres of the oxidising liquid corresponding to 1 gramme of tin). From this point the quantities of permanganate necessary are again augmented, and when the dilution is brought to $\frac{1}{12000}$th as much permanganate is needed as when it was only at $\frac{1}{4000}$th. The oxygen of the water then seems to have very little action on concentrated solutions, while on diluted solutions its action is very marked. At a certain degree of dilution, however, these phenomena are reversed, and instead of continuing to augment, the sensitiveness of the liquid for oxygen diminishes more and more, becoming gradually reduced to what it was in the concentrated solutions. In the preceding experiments no account has been taken of time; the oxidation always took place immediately after the protochloride was mixed with water. By allowing the very diluted protochloride to remain several minutes before adding the permanganate, a much greater absorption of the oxygen of water takes place, as shown by the Experiments A and B.

If the oxygen of water is the cause of these variations, they ought not to take place when boiled water freed from air is used; and in fact they do not then take place. Water was boiled, and the temperature then lowered to 80°, the protochloride was then introduced and the estimation proceeded with. The following results show that in operating thus the standard does not vary, whatever quantities of water are used.

[1] Mohr: *Traité d'Analyses*, pp. 297 and 349.

[2] *Annalen der Chemie und Pharmacie*, vol. cxiv., p. 114.

[3] *Annalen der Chemie und Pharmacie*, vol. cxvii., p. 261.

Protochloride employed.	Quantities of Water.	Standards found. With Cold Water.	With Boiled Water.
2	100	26	26
2	200	23	26
2	300	22	26
2	400	21	26
2	800	19	26
2	900	17	26
2	1,000	16	26
2	1,200	13·5	26

For studying the action of free oxygen on diluted and concentrated solutions of tin, I passed a current of this gas into various solutions of protochloride of tin. For this purpose two flasks, communicating by a tube, are filled, one with a solution of 2 cubic centimètres of protochloride of tin in 100 cubic centimètres of water, and another with the same quantity of protochloride in 1000 cubic centimètres of water. The oxygen current, forced to traverse the contents of the first flask before arriving at the contents of the second, during an hour, the liquids in the two flasks filtered and tested by permanganate of potass, yielded the following results:—

c. c. c. c.
1st Flask, containing 2 Sn Cl in 100 water, required 25·5 permanganate.
2nd Flask „ „ 1000 „ „ 9 2 „
2 c.c. Sn Cl, in 1000 of water, without oxygen current, 16·0 „

The first flask contained the strongest solution, and received the oxygen first, and absorbed only an amount of oxygen represented by 0·5 of permanganate; while the metal solution of the second flask absorbed a quantity represented by 16 — 9·2 = 6·8 of permanganate. The same experiment repeated by employing only 50 cubic centimètres of water in the first flask, and by continuing the oxygen current for two hours and a-half gave the following numbers:—

1st Flask, containing 50 c. c. of water, 2 6 permanganate.
2nd Flask, „ 1000 „ „ 3·2 „

In this case the concentrated solution of protochloride of tin did not absorb oxygen, while the diluted solution absorbed a quantity equivalent to 16 — 3·2 = 12·8 of permanganate, that is to say, nearly half the oxygen necessary to oxidise the protochloride completely.

M. Mohr's experiments prove[4] that the oxygen of water has not the slightest action upon salts of protoxide of iron, whilst under the same conditions the protoxide itself oxidises immediately. M. Mohr has taken advantage of this property to estimate by means of permanganate the oxygen dissolved in water. It is interesting then to observe whether there exists between protochloride and protoxide of tin a difference of affinity for oxygen, analogous to that distinguishing the salts of iron of the oxide. This analogy, in fact, exists, only the reactions are inverse; that is to say, protoxide of tin manifests no affinity for free oxygen, while, as we have seen above, the protochloride combines more or less rapidly with this gas dissolved in water.

(To be continued.)

On Obtaining Thorina and Tantalic Acid in Crystals, by MM. A. E. NORDENSKJOELD *and* J. J. CHYDENIUS.[1]

THE thorina employed was extracted from orangite by treating that mineral by hydrochloric acid, separating the silica, precipitating by ammonia, redissolving the precipitate in hydrochloric acid, neutralising by ammonia, and precipitating the thorina by sulphate of potassa, as double sulphate of potassa and thorina. This salt washed with a solution of sulphate of potassa was dissolved in water, and the thorina precipitated by ammonia. The previously washed thorina was again dissolved in nitric acid; then, for the last time, precipitated by ammonia, washed, and calcined. It had a slight yellowish colour. Density 9·08.

In one experiment thorina was crystallised by exposure to the temperature of a porcelain furnace in platinum capsules, with borax, in the glass formed by which the crystals were found. In another experiment a like result was obtained, with boracic acid, by Ebelmen's method. Thorina formed small brown or white prismatic crystals, sometimes ending in a base, sometimes in a quadrangular pyramid, the faces of which are sometimes hollow like those of sea salt. The authors refer these forms to the type of a prism with square base. The angle of the octohedron face on the adjacent face of the prism would be 102° 30′, which greatly resembles that of an octohedron of oxide of tin, rutile, and zircon. Thorina would then be isomorphous with these three oxides, and would then have the formula ThO_2 instead of ThO or Th_2O_3.

The density of crystallised thorina is 9·20. Tantalic acid extracted from tantalite (hjelmite) of Nya Kârarfvet, and freed from tungstic acid and oxide of tin by fusion with a mixture of sulphur and carbonate of soda, was mixed with four times its weight of salt of phosphorus. After exposure to the heat of a porcelain furnace, and being treated by hydrochloric acid, it yielded a gelatinous mass on the addition of water.—*Poggendorff's Annalen.*

Note on the Extent to which Mercury Volatilises along with the Vapour of Water at 100° C., by J. W. MALLET.

IN Berzelius' *Traité de Chimie* it is stated that Stromeyer drew attention to the fact of the evaporation of mercury in considerable quantity at 60° to 80° C. with the vapour of water, the more volatile substance carrying with it the less volatile, as in the case of a solution of boracic acid when heated.

This fact does not seem to have been very generally noticed by the compilers of chemical text-books in treating of the history of mercury, though it was always stated that the metal is capable of volatilising to a very slight extent, even when alone, at the common temperature of the atmosphere. Some doubt, too, would seem to have been thrown upon Stromeyer's observation by the experiments made, under peculiar conditions, by Fresenius, and reported by him in the appendix to his Treatise on Quantitative Analysis. It was found that 6·4402 grm. of mercury, covered with a considerable quantity of water, and heated to the boiling point of the latter for a quarter of an hour, lost but ·0004 grm., while exposure to the air at summer heat for six days produced a further loss of ·0005 grm.

I have lately observed the tolerably rapid evaporation of the metal with steam, produced not from a mass of water covering the quicksilver, but from a porous and highly absorptive clay which was dry to the touch, but gave off some eight or ten per cent. of water when heated to 100° C. A specimen of this soil had been in contact with mercury, and several grms. of the metal in small globules had become mixed up with the mass. It was placed in the common copper box with double sides which serves as a steam-bath, and exposed to the tempe-

[4] *Traité d'Analyses par Liqueurs Titrées*, p. 260.

[1] *Poggendorff's Annalen der Physik und Chemie*, vol. cx., p. 642. 1860. No. 8.

rature of boiling water. In half-an-hour I was surprised to see that the little piece of glass tube through which the heated air and vapour from the inside of the steam-bath escapes was coated with a bright specular deposit of metallic mercury. This was brushed off, and the tube replaced, when again it became in a short time similarly coated. The steam bath was kept in constant use in drying this and other specimens of soil for twenty or thirty hours, and in this time between four and five grains of mercury was collected from the glass tube. Doubtless the condensation of the mercury vapour on the latter must have been far from complete—a large proportion of mercury probably escaped into the atmosphere. At any rate it seems clear that the metal can volatilise in very considerable amount when surrounded by vapour of water at 100° C., and not at the same time pressed upon or affected by the cohesion of a mass of liquid water. Hence an obvious necessity for thoroughly effective condensation when mercury is to be determined in its compounds by ignition with soda-lime.—*American Journal of Science.*

On the Composition and Properties of Permanganic Acid, by M. H. Aschoff.[1]

Mr. Phipson's assertions relative to the non-existence of permanganic acid, already refuted by M. Machuca, are further contradicted by those of M. Aschoff. Having occasion to occupy himself with these inquiries, M. Aschoff has entirely confirmed M. Mitscherlich's long-known views relative to the composition of permanganate of potash. He also proved that violet permanganate becomes changed to green manganate with disengagement of one atom of oxygen, and that the green solution again becomes violet by the action of carbonic acid with a deposit of peroxide of manganese, according to the equation $3\ (KO.MnO_3) + 2\ CO_2 = KO.Mn_2O_7 + MnO_2 + 2\ (KO.CO_2)$.

The author afterwards occupied himself with preparing anhydrous permanganic acid. He finds that this preparation can be made without danger, even when operating with 20 grammes of permanganate, by taking care to cool the sulphuric acid (1·845 density) with a refrigerating mixture, and by gradually introducing the permanganate, which must be free from all chloretted combinations.

The dissolved permanganic acid colours the acid dark green, forming at the same time some oily drops, which fall to the bottom of the vessel, and which, after a time, or rather when the mixture is heated, disengage oxygen. Manganate of potash behaves in an analogous way. There is always a deposit of peroxide of manganese, the manganic acid immediately decomposing into peroxide and permanganic acid.

Permanganic acid forms a dark brown-red liquid, fluid at 20°, very unstable, attracting humidity and decomposing with disengagement of oxygen. It gives no trace of vapour in an exhausted receiver, and when heated to above 65° it detonates violently with flame, and is transformed into sesquioxide of manganese. Its composition answers exactly to the formula Mn_2O_7.

When permanganates or manganates contain chlorides the phenomena are different, and the yellow vapours obtained by M. Dumas[2] are produced by adding sea salt to a mixture of permanganate of potash and sulphuric acid.

M. Aschoff has not succeeded in condensing a sufficient quantity of these vapours for analysis; but he has collected and studied some small drops analogous to anhydrous permanganic acid, which are also isolated in this experiment, and the composition of which answers to the formula Mn_2ClO_6. This body may be a new combination or a mixture of anhydrous permanganic acid and a chloretted combination of manganese.

[1] *Monatsbericht der K. Preuss Akademie der Wissenschaften zu Berlin. Poggendorff's Annalen der Physik und Chemie*, vol. cxi.

[2] *Annales de Chimie et de Physique*, Second Series, vol. xxxvi. p. 81.

TECHNICAL CHEMISTRY.

On the Manufacture of Iron,[1] *by* E. Riley, *F.C.S., late of the Dowlais Iron Works.*

(Continued from page 93.)

In rolling the flange, or American rail, a particular description of cold short iron was made for the flanges to stand the strain that there necessarily must be from the rails being rolled edgeways, and the flanges not travelling at the same speed (from the less periphery of the rolls) it was necessary that the flanged portion of the rail should slip; and partially on this account, and also on account of the flange becoming colder than the mass of the rail, it was difficult to obtain a perfect flange, unless a peculiar description of iron was used. This iron was made generally with forge cinders and Welsh ironstone, without any red ore. In the bridge rail, which was rolled flat, head up and down, the iron was only likely to rip by becoming cold, and was not submitted to so great a strain as with the flange rail. For common American rails the slabs for the heads were frequently not made more than three-quarters of an inch thick, and the rails were only single-headed.

The way in which a rail has been piled, and the thickness of the top slab for the head, may be easily determined by filing a section of the rail smooth, and acting on the surface with dilute mineral acid, which dissolves the iron and leaves the cinder in the welds or joints intact.

Rails being submitted to a different strain to other descriptions of iron, it was soon found that fibrous iron, such as is used for making cable bolt was not adapted for rails, as the iron was too soft, and strips or ribbons soon began to pare off the rails. Various means have been adopted to make iron crystalline and hard. As a rule, the more you roll iron the more fibrous it becomes, up to a certain point, and for this reason many engineers have the slabs for the heads of the rails hammered, so that they may only be submitted to the drawing action of the rolls once. Since the introduction of the oolitic iron ores it has been found that, by smelting them with a mixture of a little cinder and clay ironstone, that a peculiar description of cold short crystallised iron is produced, and this iron has been very largely used for the manufacture of the heads of rails. The peculiar description of this iron is due to the phosphorus which the oolitic ores contain. Phosphorus has the property, when alloyed with iron, of making it work soft and cold short.

Rails made with this iron have been very favourably reported on by engineers. The iron, although hard, is very weak, and the author's opinion was that hard iron might be made with equal advantage by the use of manganese, without, at the same time, reducing the strength, as you do when phosphorus is present.

Some foreign engineers have even gone to the length

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of making it a clause in their specifications for rails that they shall break when a given weight is let fall upon the rail resting on bearings at a specified distance apart.

Single-heated rails require about 12 cwt. of coal to the ton, on an average, and double-heated about 16 cwt.

The author, after apologising for the very brief way in which he had considered the various processes in the manufacture of iron, next proceeded to consider some of the recent improvements that had been suggested and carried out for the manufacture of iron and steel.

The most important, perhaps, was the Bessemer process, which, when first put forth by Mr. Bessemer, in 1856, caused quite a sensation in the trade. The author was, at that time, at the Dowlais Works, and made a series of experiments on the process, which were detailed. The results of the experiments were, that only from the very best descriptions of foundry iron could wrought iron be produced which had at all the character of ordinary bar iron, and even this was of a peculiar crystalline structure, and had the appearance of burnt iron. When the ordinary forge pig, used for making bars and rails, was operated on, nothing could be done with it at all. The iron, after blowing and casting, when submitted to the action of the squeezer, crumbled all to powder and dust; and it was only by using very great care that a piece was made into a bloom and passed through the rolls, the bar was as brittle as glass, and broke, when struck, in all directions, longitudinally and transversely. The same results as the above were obtained by experiments at various other works, and only when such pig as the best Blaenavon Foundry, foreign pig, or pig made from spathose iron ore was used, that any good results could be obtained.

The author investigated the cause of the failure of the process, and on analysing samples of the pig, and the iron after blowing, he found that the whole of the carbon and silicon had been separated absolutely, as not a trace could be found; whereas the sulphur was only slightly diminished in quantity, and the phosphorus, if anything, increased. From the above it was evident that the non-separation of the latter elements was the cause of the failure, in a great measure, with ordinary white forge pig.

Mr. Bessemer instituted a series of experiments on his process, and erected works at Sheffield to carry it out practically. He soon found that he had been in error in using some of the best description and highest-priced irons, as there were others in the market which were far cheaper and much more adapted for his process. On analysis it was found that the grey pig made in Cumberland and Lancashire from the red hematites was nearly free from sulphur and phosphorus, containing not more than ·05 per cent. of the former, and ·10 per cent. of the latter. This iron is very siliceous, but by blowing the whole of this is separated; by blowing this iron, and adding after the blowing some metallic manganese, or an alloy of iron and manganese, iron or steel of any quality could be made. The author, before considering the condition in which he considered the Bessemer iron to be, detailed more experiments he had made on wrought iron in a fused state.

The results of the experiments (which had been frequently repeated) were that if the very best fibrous cable bolt iron was melted in a clay crucible (so as to be kept away from carbon), a crystalline fused button was obtained, which had somewhat the appearance of antimony. This iron, when worked by a smith, was very redshort, and after welding it broke all to pieces as the heat came down, although at a low temperature it worked tolerably well. It was, in fact, in the same condition as the Bessemer iron, and was in this state useless. On adding to the pieces of iron (from 1 to 1¼lb. were used in each pot), a very small amount of metallic manganese, from 1½ to 3 or 4 per cent. in various experiments, it was found that the lower quantity of manganese restored all the original properties to the iron, and that anything could be done with it, and it would work at all temperatures. The higher proportions of metallic manganese gave the iron a steely character, and in fact converted it into a low steel. Experiments were also detailed on the reduction of wrought iron in a fused state direct from the best clay ironstone (by leaving an excess of oxide of iron in the cinder); the iron thus produced was useless, as it would not work at a high temperature, but worked moderately well at a low heat.

The author considered that a small amount of carbon was essential to wrought iron, and by the process of melting, or the Bessemer process, this small amount of carbon was removed. By the introduction of metallic manganese, the carbon was taken by the iron, and the manganese would become oxidised, and unite with the silicon or other impurities in the iron. It was well known that pig iron, made from the spathose iron ore, not only contained a high per-centage of manganese, but also a higher per-centage of carbon than any other description of pig. This iron was generally white, the author never having seen it better than mottled, and he believed great difficulty would be experienced in getting it grey. Manganese certainly has the property of fixing carbon in iron in some way not very well understood, and when this metal is alloyed with iron he considered that the manganese would be completely separated before the carbon was touched, and in its separation the oxide of manganese, being an excellent flux, it would have a tendency to separate the impurities in the iron.

The reduction of manganese from its ores, and the difficulties attending it, were mentioned in illustration of the properties of this metal, and the author considered that the application and use of manganese in the manufacture of iron was most important.

The author then referred to drawings of the vessel Mr. Bessemer used for his process. One of the great difficulties was in getting the tuyeres to stand, as the fluxing action of the oxide of iron and the temperature in the blowing vessel was very great. In several instances a whole fire-brick had been fluxed away in twenty minutes. By using powdered sandstone, known as "ganister," the fluxing action was not so great, and a further improvement had been made by introducing the tuyere from the top, and making it altogether independent of the vessel, so that it could at any time be withdrawn and replaced by a new one.

Various other processes for the manufacture of steel were commented on, amongst others Uchatius', Mushet's, and puddled steel. The author considered that puddled steel was liable to be wanting in uniformity.

Much had been written on the composition of steel, and various theories had been propounded as to its composition, and the elements requisite for the production of the best varieties of steel. M. Frémy, had published a very extensive series of experiments, and he was of opinion that iron in its three states—cast iron, steel, and wrought iron—is due not only to the different proportions of carbon they contain, but also to the presence of nitrogen. M. Mushet, again, has started a theory that titanium is essential in the manufacture of steel.

It was a well-known fact that cyanides have the property of converting iron into steel, and after the very

elaborate investigation of M. Frémy, in which he showed that nitrogen assisted very materially the formation of steel, the author was of opinion that nitrogen might act in a somewhat similar manner to manganese—viz., as a carrier of carbon, but he was hardly disposed to think that nitrogen was a constituent part of steel. The formation of steel with pure carbon and iron was discussed, and it was thought that further investigation was necessary to prove if nitrogen was or was not a constituent part of the best varieties of steel.

With regard to titanium, this metal had a great affinity for nitrogen and carbon; and if nitrogen is requisite in the manufacture of steel, it is possible it might act as a carrier of nitrogen and carbon. A large sample of titanium (in a pure state), obtained from the hearth of an old blast-furnace, was exhibited.

The author concluded by pointing out the difficulties that there were in accounting for the different varieties of iron which were due, in some cases, to physical, and in others to chemical differences, in their constitution, and at times, perhaps, both combined. It was only by observation and carefully conducted experiments that the true causes could be determined. He was ready to admit that our knowledge was limited on the subject, and he must plead this as an apology for the imperfect way in which he had treated it.

On White Gunpowder, by F. Hudson, *Esq.*

Having lately prepared different samples of white gunpowder (according to the receipt of Dr. J. J. Pohl, given in the Chemical News, July 6) for some military engineering experiments, I have tried the process of separately grinding the materials, viz. chlorate of potash, ferrocyanide of potassium, and cane sugar, and then mixing them; also grinding them together with a little water added, and then dried at a temperature of about 150°. I find that those samples which were prepared moist and then dried are more easily exploded than those prepared by the dry process. In fact, one sample exploded in an open porcelain dish by simple friction with a spatula with which one of my assistants was crushing some of the larger pieces. Through the explosion he was laid up for several weeks and nearly lost his eyesight. No samples prepared dry are as explosive as those prepared moist, the addition of water causing a more perfect mixing of the particles of its chemical constituents than can be effected by the dry grinding process. This accounts for the greater danger attending the use of white gunpowder prepared in the moist way.

A cannon loaded with the white powder goes off on the application of a few drops of sulphuric acid (equally as well as with a light applied) to its touch-hole.

This property of the gunpowder may possibly be applied to some advantage in the construction and preparation of bomb shells for long ranges. The shells would not explode (if filled with the white powder and containing a glass vessel with sulphuric acid) until they struck the object. No useless explosion of the shell could take place in the air, as is too often the case with the ordinary fusee shell.

Its expansive or explosive force is also twice that of common gunpowder. In all experiments performed with this white gunpowder care must be taken not to compress it too violently; otherwise accidents may frequently occur. A blow with a hammer upon stone with some of the powder upon it explodes all samples that I have prepared.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

A Course of Two Lectures on Musical Acoustics, and on the Physiological and Psychological Causes of Musical Harmony and Discord, by Professor Hermann L. F. Helmholtz, *of Heidelberg.*

Lecture II.

I have had the honour of bringing before you, in my first Lecture, the theory of the composition of waves of sound; at first, the composition of such waves as were of independent origin, and where the composition was a real composition of different systems of waves. I have also explained to you that a wave of any arbitrary form can be considered as a composition of a number of waves of simple form—of waves in which the motion of every particle corresponded to the motion of a pendulum, and calling these vibrations simple vibrations, we may call such waves simple waves. Therefore, a wave of any other form can be considered as a composition of a number of simple waves. It is shown by the French mathematician that this is always possible, and that any form of wave can be composed by simple waves into one, so that the intensity and the phase of every small wave is known, if the form of a complex wave is at first given. Now, this composition of a complex vibration by simple vibrations is only an imaginary composition. We may consider it in the same way as we may consider every quantity, every number, as a sum of parts. Further, we find that this composition, which is a sort of composition of simple waves, is not only an imaginary composition, but that the human ear makes the same analysis of complex waves as if they were really composed by simple waves. My last experiment was on the monochord, where I tried to show you that, in the sound of the string, if I move the whole string, there, the simple sounds are contained which must be composed in order to get the whole motion of the string.

Now, you will usually find it very difficult to hear the harmonic sounds of the string—to hear the sounds corresponding to the simple vibrations of the string which are kept together in the whole motions. These harmonic tones have been known for a long time, but they have been commonly considered as rare and accidental phenomena of small intensity and of small importance. Philosophers believed they were of small intensity, because it was difficult to hear these tones. But this difficulty is of a very peculiar kind. We should think that nothing could be easier than to feel the sensations of our nerves; but that is indeed not so simple and not so easy as it appears. We are exercised and educated for using our senses, and even in the most common perceptions by our senses there is more exercise than we commonly are inclined to guess. We are exercised to judge by the sensations we get of the real nature and form and quality of the external objects which surround us, and we accomplish this business with the greatest accuracy—with really astonishing accuracy. But we are also in the same way exercised to abstract from all those parts of our sensations, which are necessary for the comprehension of external objects. Every one who has studied the subject of visual phenomena and other sorts of internal sensations, knows how very difficult it is to be attentive to the sensations which are excited by the interior irritations of our nerves. There are a great number of phenomena in the eyes. For instance, there are little filaments which swim about in the vitreous humour, which are only seen if the eye is diseased. And you will remember the celebrated experiment by which the French philosopher excited the curiosity of King James I. of England and his courtiers. He found out that there is a blind spot in every eye, and

that there is a part of the object of vision which is not seen at all. I shut my right eye and look straight forward with my left eye, and bring this piece of red sealing-wax in front of it. If I bring it here I see it, if I bring it there I see it, and so on, but there is a place where it is not seen. Now I suppose that everyone of you who has not made this experiment but whose attention has been drawn to it by others, will hardly believe that—you will doubt it. But such a spot is in every eye. Take another phenomenon of the same kind. Mr. Wheatstone has shown that the correct perception of the dimensions of every object before our eyes depends upon the comparison of the two different images given by our two eyes. You all know that this can be quite clearly proved by the stereoscope. Now, if you look at any solid object before you, I doubt that you will be able to perceive that the condition of the form of the object depends upon the union of the two perspective images which are given by both your eyes. Now, the same difficulty exists for the harmonic tones. If we hear the sound of a string, we always hear the fundamental tone accompanied by a number of harmonics. This whole sensation composed of the fundamental and the harmonics we consider as the sensual sign for the sound of a string. We perceive by this complicated sound that the string is tuned. If there is another combination of harmonic sounds, we guess that there is another instrument sounding. So that we are exercised to distinguish this complicated sensation; but we are not at all exercised to distinguish and perceive the simple elements which are contained in such a complicated sensation: therefore this difficulty of perceiving the harmonic tones is not caused by the small intensity or rareness of harmonic tones; it is not the difficulty of sensation; it is only the difficulty of perception of these tones. It was, therefore, quite wrong to suppose that these harmonic tones are rare or accidental phenomena. Although it is very difficult to hear them, and it requires much exercise, and a peculiar help that we may succeed in directing the attention to these tones. I must say I have exercised myself much in different ways to hear the harmonic tones, but I was always doubtful as to their intensity; and I could not succeed in comparing by the ear alone their intensity in different instruments. The enquiry of the unassisted ear is of great importance in these researches, because it is necessary to show that harmonic sounds are heard even by the unassisted ear. Now, I strove to find a method for hearing the harmonic sounds more easily, and for becoming sure that there was in the tone of any instrument such harmonic sounds, or that they did not exist; and at length I found a method which is quite convenient and simple. I use for that end these glass spheres; they are tuned to different pitches. Here you have a sphere which is tuned to B flat. If I bring the tuning fork before the mouth of the sphere, the air resounds and gives the sound of the tuning fork, and always with great intensity. If the note which corresponds to the pitch of this sphere is produced in the external air, then the interior air of the sphere is violently shaken and vibrated. If I place this sphere to my ear, then I hear the note of the sphere. Every tone when this note is produced in the outer air, be it a fundamental, or be it a harmonic sound, or as a part of a great mass of different sounds. So that I hear, then, this sound corresponding to the pitch of the sphere with great intensity, and all the other sounds which are produced in the same time come to my ear with much less intensity; so that it is very easy to find out if there exist any harmonic tones of a given pitch in any mass of sounds which are produced together in the outer ear. Now, by this means it was very easy to find the harmonic sounds of all musical instruments. I find that there are very few instruments entirely free from harmonic sounds. The best method for getting really the simple sounds is this which I have applied—to bring the tuning-fork before the sounding cave filled with air, which is tuned to the same pitch. Therefore this kind of sound is really simple sound. We can produce the same kind of sound also from the stopped organ pipes. They gave simple sounds accompanied with a little noise of air. This is a sound of the same kind. The sound of the pipes is not quite so pure as the tuning fork, but it is nearly devoid of all harmonics. Now, the sounds of all other musical instruments contain harmonic sounds of more or less intensity. The most similar to the stopped pipes of the organ are the open pipes; you hear these a little more clearly. The sound of the open pipes, if they have a great section, contains only the first and second harmonics; and if they have smaller sections then the sound is more sharp and it contains more harmonics—to the fifth or sixth. You hear that these sounds are sharper; they are so because they contain more harmonics. Now, these harmonics always give consonant intervals when connected with each other: but the higher harmonics give dissonant intervals,—they are nearer; and therefore such instruments which have very high harmonic sounds sound sharp, and have something disagreeable in their quality of sound. If you will compare the sound of the stopped pipe, or the sound of the open pipe, and the sound of the reed pipe, of the same pitch, you may also perceive that the simple sound appears to be lower than the complex sound of the reed pipes. The fundamental sounds of those two pipes are really the same, but the reed pipe contains high harmonic sounds and therefore the one sound appears to be higher than the other sound, and you hear this difference very plainly. Now, it is not possible, by these means, to ascertain the intensity of harmonic sounds. This can be done for some instruments by mathematical theory. The mathematical theory of the motion of strings is able to give for different methods of exciting the string, the amplitude of the harmonic sounds. For the piano, if its common point where the string is met by the hammer, is $\frac{1}{8}$th of its length, you have the fundamental sound and the different harmonics. The 8th harmonic is wanting, and the higher harmonics are very feeble, if the hammers are covered with leather, as it is common. Here you have the same for the guitar, if the same point of the string is excited you see the 8th is also wanting. Here also you have the harmonic sounds for the violin, the first sounds are of less intensity than those of the piano or the guitar, but the higher harmonic sounds are not wanting; and therefore the sound of the violin is sharper than the sound of the piano and guitar. A very striking and interesting example of changing the quality of the sound is given by the reed pipes, if they are connected with different tubes filled with air. The human throat contains such a reed pipe in the nerves, and the cavity of the mouth represents the tube which is connected with the reed pipe. Now the cavity of the mouth can be tuned by changing its volume and its opening to different pitches. And we find by enquiring into the quality of the sound with these spheres, that the harmonic sounds of the human voice are different for different vowels, and that different vowels are produced by giving to the cavity of the mouth a different pitch. We can do the same by the reed pipe. The theory of producing vowels in this way was first given by Mr. Wheatstone after the experiments of Mr. Wills. Here I have a common reed pipe of a very sharp sound, it is like *A* spoken through the nose. Now the pitch of this reed pipe is *B*, of two feet length, given by organ pipes. If I put upon this a glass sphere, which is tuned to the same pitch, you have a sound like *oo*. If I put upon it a sphere tuned an octave higher, you have *o*. If I put upon it a sphere two octaves higher than the first one, you have *au*, and so on. In this way different vowels can be produced, and are produced in the same way by the mouth. These harmonic sounds which are near to the sound of that sphere with the sounding cavity, are always produced with greater strength. That the cavity of the mouth is tuned to different pitches, can be immediately

ascertained by tuning forks. You saw that the sphere resounds for this tuning fork. If I put my mouth into the position for giving the vowel *o*, you hear the resonance of the tuning-fork. The pitch of the mouth is the deepest for *oo*, and then you can get *o*, *au*, *ä*, *ah*, for the higher vowels, and so it goes on from *ah*, *a*, *e*, *ee*. This other tuning-fork is $\frac{1}{2}$th higher than the first, and resounds for *ah*. If I put my mouth into the position of *o* or *oo* you hear nothing. In this way, therefore, you can ascertain the pitch of the cavity of the mouth; and it is stated by the theory of Mr. Wheatstone that those harmonics which are near to this pitch, which is constant for every vowel, and is the same for female and male voices and voices of children,—the harmonic sounds near to this pitch are of greater intensity, and the others of less intensity; and by this composition the vowels are distinguished. Now, it was a question of great importance for the physiologist to ascertain whether such sounds can be also composed by their harmonics not produced in the common way. Because, by such experiments it was possible to ascertain if only the existence and intensity of harmonic sounds is sufficent for producing a given quality of sound, if there are also other differences, if there are other influences necessary for getting the quality of the vowel sound. For this end I have composed an apparatus consisting of some tuning-forks. Every tuning-fork is connected with a sounding cavity, a green cylinder, and put between two branches of an electric magnet. The electric magnet is magnetised by an interrupted galvanic current. The galvanic current is produced by a battery; the interruption is caused by the vibrations of another tuning-fork, the ends of which are connected with the platinum wires, and dipped into mercury if the tuning-fork is swinging, so that by the vibration of this fork the current is interrupted, and we have here 240 interruptions of the current in a second of time. The first tuning-fork in the sounding cavity makes 240 vibrations in a second; the second makes twice as much, the third three times as much, and so on. So that the other tuning-forks give the harmonic tones belonging to this fundamental sound. If I let go the interrupted current through the spirals of the electromagnet, then the tuning forks are brought into vibration because at every magnetization of the iron they are attracted and then go back and then are again attracted, and so on, so that they go in continuous vibration. As long as the ends of these resounding cavities are closed, you will not hear the sound of the tuning-forks, or will hear only a very small intensity. If I open the ends here by a little key, then you will hear the sound, and in this way I can alter the intensity of the sound by opening completely or incompletely the mouth of the cavities, and so I can compose the fundamental sound with any given number of harmonic sounds. This is the fundamental sound; the higher sounds are very feeble; the sound becomes similar to *o*, and, therefore, I make *o oo*. The higher tuning-forks give *a* or *ah*, or the German pronunciation *a*, *o*, *oo*.

In this way, therefore, we can compose artificially the quality of these sounds. You will hear it better perhaps after the end of the Lecture, if you come nearer to the instruments. The sound is a little feeble for a great room, and I cannot strengthen the intensity of the current, because then the sparks become too intense, and volatilise the mercury. So, therefore, it is possible to compose in this way the different qualities of sounds, and to make them similar to the sound of the different musical instruments. The quality of the sound of the vowels is a very favourable example for that, because the vowels have only a musical sound, and other noises which commonly accompany the sounds of other instruments, as the sound of the rushing of air, or the rubbing with the bow on the string of the violin, and so on, are wanting in the vowels, and the vowels are different only by the musical part of their sound, and of course we can only imitate the musical part of the sound by this tuning-fork. The fundamental question to decide by these means, if only the existence and intensity of the harmonics is wanted for giving equality of the sound; if perhaps also the difference of phase is different, and has influence upon the equality of sound. For showing the sense of this difference I have here the wave-machine of Mr. Wheatstone which I suppose you have often seen. You see here [pointing] a wave of long vibration, and there, one of shorter vibration, where two waves come to every one wave of the higher. The one corresponds to the fundamental sound, and the other to the octave. Then the upper curve shows the combined vibration. You see at present the hills of the inferior wave correspond to the hills and the valleys of the superior. There you will see that the phases all agree; both are coinciding in these two and they give here [pointing to the upper row] these greater heights. We can alter the figure and get different curvatures. Now, by these experiments I found out that only the intensity of the harmonics is wanted, so that all these curves we get above would correspond to the same quality of sound, and that gives no difference of quality of sound, so that only the existence of these is what we want. Therefore the quality of the musical part of the sounds is only determined by the existence of the harmonics. So much about the quality of the sound.

I come now to the influence of the harmonic sounds upon the consonants and dissonants. For finding the cause of the dissonance of two musical sounds we must consider another phenomena, the phenomena of interference of sound. Two sounds can be combined in that way,—two sounds of equal pitch can be combined in this way, that every sound gives an impulse to the air in the same direction, then the intensity of the two sounds is strengthened, they help each other, the vibration of the air becomes greater, or two sounds of the same pitch can be combined together, so that if the one gives an impulse the other goes back, and the impulses are given alternately. Here the motions of the air corresponding to these two sounds are contrary—opposite—and destroy each other. We may combine on the wave machine of Mr. Wheatstone two sounds of the same pitch. Here we have the combined wave. The hills correspond to hills, and the valleys to valleys, therefore in the combined wave you have higher hills and deeper valleys. If we alter the phase of one of these so that hill corresponds to valley, and valley to hill, then you see that the composed curve becomes a straight line. There the hills fill out the valleys of the other line which corresponds to the same point. The two sounds destroy each other, their impulses upon the air are of opposite direction and they destroy each other; so that the air which is shaken by their single sound becomes quiet if both the sounds are combined. Now if the air is quiet we hear no sound. We can produce such a combination by the sirene you saw only lately; because I can here alter the position of the holes of the upper box. I can put this box in such a direction that the holes are opened at the same time and the impulses of both boxes come to the ear in the same tune or I can put them in that position that the impulses come alternately, then the sound is destroyed. It is not completely destroyed, because the motion of the air produced by the sirene is not quite simple, and therefore the form of the hills does not correspond exactly to the form of the valleys, and there remains a small intensity of sound. The fundamental sounds destroy each other; but the first harmonic sounds remain; therefore, though the sound becomes more feeble it does not quite cease, and goes up in its higher octave. We have, you hear, alternately greater and smaller intensity, coincidence and interference, Now, if I turn round the axis of the upper box, then I come at first to two points of coincidence and interference and again a point of coincidence and interference, and so we have alternately coincidence and interference. We have, then, a phenomenon which is called beating of the sound.

Now, you know that, if I turn the axis one way, the pitch is heightened, and the other way it is lowered. Therefore, you see that, by giving to the upper box such a motion that the pitch of the sound is a little altered, then we get alternately coincidence and interference, this strengthening or lessening of the sound. So that, therefore, by altering the pitch of one of these sounds by a small quantity, we get this phenomena of beatings. The phenomena of beatings can be produced on all other musical instruments. If we connect two sounding instruments which have nearly the same pitch, but not quite completely, the number of the beatings is always corresponding to the difference of the number of the vibrations. The beatings are very complete. If we have simple sounds, as, for example, by two stopped pipes—when they are of the same pitch you hear no beating, but if I alter the pitch of one, the beatings are heard very distinctly. Here the beatings are separated merely by complete intermittence of the sound. If I take two other pipes which have the harmonic sounds, then the beatings are not so complete, because, during the time where the fundamental sound ceases, the first harmonic sound is strengthened. I take two of these metal pipes, and at present you have an unison, but by altering the pitch of one, the beatings are produced. In the same way the beatings can be produced by other musical instruments. Consider what takes place in the ear during this time. If the tympanum of the ear and the air in the ear is not vibrating, if there is repose, then we still have no sensation at all—no sound. The phenomena of beating, as long as we consider only the motion of the external air, is no exception from the common rule of undisturbed composition of the different sounds. You see that this machine of Mr. Wheatstone's, which possesses different vibrations, produces interference by adding, or by summing the vibrations together, after the common law. Therefore, this repose is produced by the common rule, that vibrations are added without disturbance. But it is another thing with the sensations of the ear; the sensation of two sounds have no two different phases. If we add one sensation to a second tune, we cannot expect to get the same by this addition; we should always expect that we should have the double sensation, but that is not the case. In the sensation of the ear there really is a difference; the sensations in the ear are not always summed together by the common law, and we cannot consider the sensation of two system of waves like the sum of the sensation of the ear. The ear is a resounding body. Perhaps there are, in the interior of the ear, little elastic bodies, which resound differently for every pitch. This drawing [pointing to a diagram] represents parts of the internal ear. It is like the shell of a snail, vaulted, hollow, just separated by a wall, which is one-half osseous, and the other membranous. The nerves represented by the white stripes come to the osseous part, and then to the membranaceous part; there we find little elastic arches, called commonly the organs of concha. They are little elastic arches, of a very small size, which are connected with the nervous pipes. These little elastic arches spring if the membrane is shaken by the vibration of the air; and if we suppose that these elastic arches are tuned every one for a different pitch, then it would follow that, by every external sound, only one, or very few of these elastic bodies are put into vibration, and that only one or some nervous fibres are excited, the others remaining quiet, so that all the sounds of different pitch are also felt by different nervous pipes. Now, if we take another sounding body, the air of this little flask, and if I bring two tuning-forks before the mouth, you will hear the beatings, which show that the air in the interior of the flask is at first vibrating and then not—alternately vibrating and not vibrating. [The Professor excited the tuning forks, and held them before the mouth of the flask, when the alternate vibrations were distinctly heard.] Here the vibrations of the air are excited by the tuning forks; in the same way the vibration of the little elastic bodies in the air must be excited by the external sounds If two sounds come together which give interference, then the elastic bodies must repose, and the acoustic nerve cannot be excited. In this way we may explain that we can distinguish by our sensations the sounds of different pitch—indeed the sounds of different pitch seem to be the sensations of different nerves. We may explain further, that we separate the sensation of a complex sound into its single harmonics. This would be a real explanation of this curious fact, that we separate such a sound, which is not separated by the manner in which it is produced, not separated into single parts, but really by the complex sound as the sound of a string. All those particles must be put into vibrations which correspond to the fundamental sound, or the harmonics of the external sound; and we can give in this way an explanation of this curious analysis of sounds. Now, we will consider the beatings of two similar sounds if the difference of the sound becomes greater. We have had hitherto only small differences of the sound. You have heard the beatings quite plainly. Now, I can alter the pitch of the sound so that there shall exist great difference of pitch; then the beatings become very swift. This is nearly a difference of a semitone, and you hear the beatings very plainly. If you take a single tone also, you hear the beatings much more plainly. Then the number of the beatings is double—the natural c and the sharp c, the octave higher, is twice as fast. Here the beatings become almost distinct, and you will distinguish very well how the slow beatings pass into the swifter beatings—[striking a lower note]; and therefore we have here the same phenomenon, only with great velocity—[striking lower notes]. Now this, I may say, is the real cause of the dissonance. If two sounds of nearly the same pitch are combined, they are not felt. They destroy each other sometimes, and strengthen each other at other times; so that they do not flow away in a continuous manner like the single sound, but they agree with each other, and disturb each other. Therefore, combining two distinct sounds by the single tone, we have beatings. Beatings, as I have explained to you, is an interrupted sound; and we have also an interrupted sensation in the ear. An interrupted sensation in the ear is disagreeable to the ear. It is the same with all other interrupted sensations. If you take a quivering light which falls upon the eye, you will be dazzled, and you cannot bear such a light a long time. You may compare it with scratchings on the skin. That is also a discontinuous sort of exciting the nerves of the skin. This same sort of disagreeableness exists for the ear, and makes it troubled; but by the sensation of two sounds which come to each other. I have given you by this the first phenomenon of dissonance. I would like to explain to you the dissonance of the harmonics, if you will allow me. I will show you by the sirene that really interrupted sound gives quite the same impression to the ear. I can put into the sirene here a little reed pipe, which gives a high tone. It is put into this box and the disc is turned. The holes here in the under side of the box are opened and closed alternately, so that the sound and the current of air can go out or is closed in. This interrupted sound which is then not a beating sound—not produced by the beating of two sounds, gives quite the same impression as a really beating sound, a sensation of dissonance, such as an interrupted sound. But we have also other dissonances of two sounds, which are not very near in their pitch: the dissonances of the impure octaves, and so on. In this case we must consider that nearly all musical instruments give harmonic sounds, and even these instruments which are of the best application in music, as the piano, the violin, the guitar, and sharp organ pipes. All these have harmonics of great intensity, and these harmonic sounds must all give beatings. We may show that in the organ. Here we have the sound of a stop pipe with feeble harmonics; but I may combine it with the higher sound, and thus give another quality of

sound. I connect it with the octave as it is connected in some of the registers of the organ which are called mixtures of the organ. Now, if I combine with this pure octave an impure octave, I make this beating: you have really in this case the beatings of these two sounds, but neither of these can be the harmonic, neither sound for instance in this reed pipe. You can hear the beatings and so on. If I take the fifth, then, these sounds have harmonics. If they are the harmonic sound of the lower and the harmonic sound of the higher, they will give no beating, but if they are not quite the same, then we shall have beatings. This is upon the fifth. You hear the beatings, they come swifter and swifter, the more the sound is altered. Now, if we suppose this theory that the difference of the pitch is felt by the different excitation of the little elastic sounds which are connected here with the ends of the nerves, we can calculate, for instance, from two sounds of a violin which are brought together, the amount of roughness which is produced by the intensity of beats of the different harmonics. We know the intensity of the different harmonics, and we can calculate by theory in what instances, the different little elastic solids will swing with each of these sounds and their harmonics, and we can calculate the intensity of the roughness, the intensity of the beatings which are produced by these two sounds.

Now, suppose that this drawing [pointing] represents the interior of an octave, the harmonic sounds, and that on the violin the sound is produced representing the fundamental sound of this octave, and another sound in any given interval of this octave from the first fundamental sound is produced at the same time. Then these little hills which are drawn above the curve represent the roughness of the intensity of the beatings which are produced by different harmonics of the two sounds. This lower curve represents the beatings produced by the fundamental sound, the black one the beatings produced by the first harmonic of the fundamental; the green the beatings of the second harmonic; the yellow the beatings of the third harmonic, and so on. Now, you see that here remain some valleys between these hills. These valleys correspond to such intervals where the roughness is a minimum, and you see the roughness is a minimum at first when the two sounds are in unison. The one is the octave of the sound. Then we have a deep valley which corresponds to the best consonants of the octave and the fifth. Then we have the other valley which corresponds to the fourth, one to the major third, minor third, the major sixth, and then a very imperfect consonance, the minor sixth. And here remains a place which corresponds nearly to the consonant interval which is not used in music—the natural seventh. Therefore you see that, calculating only by theory, the roughness of the beats we get quite completely, not only the places for the consonant intervals of the scale, but even the different degrees of the consonant intervals. Here the valley of the fifth comes down to the basis; that of the fourth not quite to the basis; that of the major third is still higher, and the minor third more so, and so on. And so we get the series of these consonantal intervals.

In this way we can give a complete account of the difference of consonance of these intervals. I must remark that as we have some qualities of sound without harmonics it seems that these would give no dissonances if they are not two sounds coming together. But in this case there is another phenomenon,—sounds of combination which I cannot describe here; they cannot be the subject of a public Lecture, because they are only heard by great attention and if one is quite undisturbed. It is a phenomenon which is not easily observed. I will only remark that for such cases where the harmonics are not very intense these combination sounds can also produce beatings, and that by those beatings of the combination sounds the dissonances and the consonances are determined in these cases where the harmonics are wanting. Whilst you will hear very easily the roughness of consonance, it is very different if the quality of the sound is altered. I will alter the pitch of the octave. In the sound with strong harmonics you hear the beatings. Here the open pipe, they are there also perceptible, but not so sharp as before. In the stopped pipe they are of less intensity and so on. Now, these stopped pipes give, indeed, dissonances, but they are so feeble that the stopped pipes in the organ cannot be used for music in common. They are too soft, and have too small an amount of energy. The dissonances give energy; if the difference between consonances and dissonances is wanting, we feel a want of energy in the music, and, therefore, the stopped pipes can only be used exceptionally. And even the organ pipes have all too small an amount of harmonic sounds, and, therefore, if the intensity and energy of the organ is required, all these mixtures are used—that is, we combine artificially with other organ pipes some organ pipes which give the harmonic sounds of this pipe, so that we get the strong intensity of harmonics.

I shall conclude this Lecture by a more general consideration of the nature of that which impresses our mind as beautiful in the fine arts. The question which is illustrated in a very striking way by that which we have said on the theory of the harmonic. That there are laws to form every sort of beauty cannot be doubted, for we cannot alter any work of art arbitrarily without destroying its beauty. It may be a picture, statuary, a work of poetry, or a piece of music, but these laws are not given by our understanding. Some of them, indeed, can be expressed in the form of practical rules; but always the highest degrees of artistic beauty are those which are understood and described in the most difficult way. Philosophers, therefore, long ago have stated that there are laws of beauty—that beauty must agree with innate laws of our mind, that it reveals these laws to the immediate perception of the senses, and that we feel its communication without being conscious of it. We may, indeed, understand and explain some parts of that beauty, some of its most striking features, but we would not be inclined to acknowledge as beautiful, in the artistic sense, a work which we know to be the effect of mere calculation and logical conclusions. Such a work always appears poor in beauty. We must feel that there is a larger stock of truth, nature and passion, in any work of art than we can derive by the mere speculation of the understanding; then such a work of art appears to us as infinitely rich; it appears as a revelation of that original harmony, consistency, and truthfulness, which belonged to the human mind, as it came from the hands of its Creator, before it was contaminated by egotism and stunted by the constraint of every-day life. This paradox has always puzzled philosophers.

We ought to feel the latent consistency and lawfulness of beauty without becoming really conscious of it, and without understanding it. Our present subject, however, gives a fine example of this process. We have in the present case only the most simple elementary rules of harmony, we have nothing to do with the higher rules of melody and musical composition. The consideration, however, which I have brought before you applies also to these elementary cases. We have seen that harmony is different from disharmony, by the beating of harmonic sounds. Now we have the sensation of these harmonic tones in our nervous apparatus; the existence of these sounds is level, also in the common use of the ear, or the difference we perceive between sounds of different qualities. But commonly, without performing philosophical experiments, we are not conscious of the existence of the harmonic tone in the sensation of our ear, and therefore of the phenomena depending on the existence of those tones, as, for instance, their beats are felt and an alteration of the quality of the sound commonly has a sort of roughness, we perceive very well that chords agreeing with the laws of consonance and agreeable to the ear are beautiful, and

different from dissonant chords, without being able to perceive the cause of this difference. Therefore we have here such a law of sensation as I have described before; we feel that two sounds coming together either agree or disagree, but we cannot say why they agree or disagree. In this way the general rule of artistic beauty is kept also in this case, where we have to do only with the more elementary part of music; for, of course, these our explanations are not sufficient to answer for the higher beauty of music, for its power and its softness, and you may expect that a long time will pass on before we shall be able to understand their mechanism. At present I think we must be content to have thrown only a glimpse into the first elementary questions of this beautiful subject.

NOTICES OF PATENTS.

145. *Preparation of Non-conducting Substances for the Deposition thereon of Metals by Electric Action.* B. Piffard, Caroline Villas, Kentish Town, London.

In our second volume, p. 323, will be found a communication from Mr. Piffard on this subject. He has, it seems, further improved upon the process there given, and now takes out a patent for it. In carrying this invention into effect, the surface to which it is desired to impart a metallic coating is washed with a solution of nitrate of silver, in such a manner that a film of the solution adheres to the whole of the surface, which is then thoroughly dried, and afterwards exposed to the action of sulphuretted hydrogen gas. The result of this process is, that a conducting surface of metallic silver will be produced, which can then be treated by any of the known methods of obtaining the electro deposition of metals. If the surface under treatment will not retain a complete film of the solution of nitrate of silver, it should be previously washed with a thin solution of gum, or other suitable substance, and then dried, before applying the solution of nitrate of silver.

This is likely to be very successful, and will be a decided improvement upon the old methods of obtaining this result by the use of black lead or metallic powders.

163. *Cast Steel.* R. Mushet, Coleford.

This invention consists in adding to steel, or to any mixture of materials which, when melted, produces cast steel, a mixture of granulated pig iron, cast or refined iron, and pulverised titanium ore, titaniferous iron ore, titanic acid, or oxide of titanium, and melting the said steel-producing materials, and the said mixture of granulated iron and pulverised titanium ore together in the melting-pot, in order to alloy the titanium contained in the said ore or oxide with the cast steel melted from the mixture of steel-producing materials, operated upon so as to produce thereby an improved quality of cast steel. And, secondly, in adding to steel, or to any mixture of materials which, when melted, produce cast steel, a mixture of granular iron and deoxidised ilmenite or compound ore of titanium and iron, and melting the said steel or steel-producing materials and the mixture of ore of titanium and iron and granular iron together in a melting pot, in order to improve the quality of the cast steel obtained.

175. *Telegraphic Cables.* J. Chatterton, Highbury Terrace, and W. Smith, Pownall Road, Dalston.

For the purposes of this invention, in order that the gutta percha insulating coatings should not be subjected to heat in the process of manufacturing a cable—as has heretofore been the case when applying hot pitch, resin, and other matters, together with or after the fibrous materials and wire coatings have been applied round the gutta percha coated wires—the patentees apply oxides or carbonates of lead, or other preparation of that or other metal, combined with tar, oil, or varnish, together with the fibrous materials, and externally of the insulating gutta percha coatings, whether wire be employed as well as fibrous materials to give strength to the cable or not. For these purposes the fibrous material used, whether made up in the form of tape, yarn, cord, or otherwise, is coated or saturated with the paint or composition above mentioned, and by preference in the act of applying such fibrous materials and whether such fibrous materials are wound spirally around or laid longitudinally over the surfaces of the gutta percha; and it is preferred to bind an uncoated tape exterior of the saturated coatings of fibre, in order that the cable may be at once coiled.

For obvious reasons, we think the introduction of any metallic compound in an insulating coating inadmissible; especially when, as in this case, we do not see what good end is gained by the addition.

106. *Iron and Steel.* W. Longmaid, Inver, Galway.

This invention has for its object the alloying of iron and steel with minute quantities of gold and platinum, thereby greatly increasing the strength and otherwise improving the quality of the metals so treated. The gold and platinum are combined when in a melted state with the iron and steel when they are in a melted state, or in the progress of their manufacture. There is no doubt that the quality of steel and iron would be improved by this addition. Faraday proved that long ago; but we fancy that steel manufacturers would look twice at a sovereign before throwing it into the melting-pot. Mr. Longmaid need not fear infringements of this patent.

197. *Glass.* W. W. Dobeson and G. Warren, Bill Quay Bottle Works, near Gateshead.

These improvements consist in using air under pressure under the gratings of the furnace, by which the draught through the fuel may be insured and rendered more constant and certain, notwithstanding the changes of weather. The air is forced into a closed ash-pit under the grating or fire-bars of the furnaces by means of a fan or any other suitable blowing apparatus.

Grants of Provisional Protection for Six Months.

1646. John Cass Smart and Adam Aitchison, Scarborough, Yorkshire, "Improvements in the manufacture of charcoal."—Petition recorded June 27, 1861.

1856. William Edward Gedge, Wellington Street, Strand, London, "Improvements in the preparation and clarification of the saccharine matters obtained from beet-root, sugar-cane, Indian millet, and other saccharifcrous vegetables or plants."—A communication from Louis Constant Bernard, Wasserling, Haut Rhin, France.

1858. Alfred Wood, Lewes, Sussex, "Improvements in apparatus employed for fermenting purposes in brewing beer, as also for storing beer, and for general purposes of fermentation."

1892. Charles Constant Joseph Guffroy, Lille, France, "Improvements in preparing medicinal substances and compounds from the livers of cod and other salt water fish."

Invention Protected for Six Months by the Deposit of a Complete Specification.

1947. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "An improved odontalgic elixir."—A communication from Jean Pierre Tajan, Paris.—Deposited and recorded August 6, 1861.

Notices to Proceed.

825. John Gay Newton Alleyne, Butterly Ironworks, Alfreton, Derbyshire, "Improvements in machinery employed in the manufacture of iron."

853. Thomas Goulston Ghislin, Hatton Garden, Holborn, London, "Preparing, applying, and adapting certain vegetable productions called *Eiklonia-buccinalis*, *Proteaceæ*, *Juncus Serratus*, *Juncus Trista*, and *Armyllideæ*, to further new purposes of manufacture, and certain modes to effect the same."—Petition recorded April 6, 1861.

876. Francis Taylor, Romsey, Southampton, "Improvements in apparatus for receiving, drying, and deodorising human excrement."

877. Frederick Ransome, Ipswich, "Improvements in the manufacture of artificial stone and cement or plaster, and in treating timber for the purpose of preserving the same."—Petition recorded April 9, 1861.

935. Robert Hodgson and Enoch Holden, Carlisle, "Improvements in the manufacture of soap."—Petition recorded April 16, 1861.

1012. Michael Henry, Fleet Street, London, "Improvements in apparatus for aërating liquids."—A communication from Jean Auguste Bazet, Boulevart St. Martin, Paris.—Petition recorded April 23, 1861.

1051. Ferdinand Charles Warlich, London Street, Fenchurch Street, London, "Improvements in preparing coal used in the manufacture of artificial fuel."—Petition recorded April 26, 1861.

1802. Charles Constant Joseph Guffroy, Lille, France, "Improvements in preparing medicinal substances and compounds from the livers of cod and other salt water fish."—Petition recorded July 29, 1861.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Magnetic Chrome Oxide.—Geuther describes (*Annal. der Chem. und Pharm.* Bd. cxviii. s. 61) a process for procuring the magnetic chrome oxide (first obtained in the amorphous state by Wohler) in a crystalline form. He passes the vapour of acichloride of chromium evenly, and not too quickly, through a glass tube a foot and a-half long, heated in a combustion furnace. The ignited charcoal is placed so that it does not come into contact with the tube. When the tube has cooled, the inside is found to be covered with small glistening crystals, which, by their brilliant appearance and colour approaching to violet, may be easily distinguished and separated from the black crystals of the ordinary chrome oxide formed here and there in places where the heat has been very strong. The sparkling violet crystals are strongly magnetic, and must be crystals of the magnetic oxide. Care must be taken not to raise the heat too high, but the most crystals are formed when the tube is raised to the highest temperature allowable.

Geuther found that this magnetic oxide of chromium contains more oxygen than the green oxide. That prepared by the author lost 6·55; 5·88; 5·14 per cent. of oxygen when converted into the oxide Cr_2O_3. If therefore, it is not considered as an independent oxide, it may be regarded as a compound of 2 atoms of chrome oxide and 1 atom of chromic acid. The crystallised magnetic oxide once formed is a very stable compound; but by long continued heating it may be converted into the green oxide, the crystals retaining their original form. The same change takes place quickly when the crystals are heated in a current of hydrogen. In the amorphous state this oxide is a black powder insoluble in hydrochloric, nitric, and nitro-hydrochloric acids, or even in a mixture of fluoric and nitric acids. By boiling in a strong solution of the fixed alkalies it is slowly converted into chrome oxide and chromic acid, and quickly undergoes the same change when fused with hydrates of the alkalies. The sp. gr. at 10° is close upon 4; it stands, therefore, in this respect between that of chromic acid 2·63, and that of the crystallised green oxide 5·21. The crystals appear to be prisms with a rhombic base. Some magnetic oxide appears to be formed when pure chromic acid is heated alone or in a current of oxygen.

Nitro-iodic Acid.—The yellow body obtained when iodide is treated with mono hydrated nitric acid, Kaemmerer regards (*Journ. für prakt. Chemie*, Bd. lxxxiii. s. 65) as nitro-iodic acid, or iodic acid in which one equivalent of oxygen is replaced by one atom of nitric oxide. The formula therefore is $(IO_4\ NO_2)$. The substance is most easily prepared by rubbing iodine in fine powder with a mixture of equal parts of ordinary fuming nitric acid and strong sulphuric acid. It is a very unstable compound. When dried over lime under a glass bell it decomposes, giving off nitric oxide gas. Water destroys it. A very small quantity brought in contract with absolute alcohol, ether or acetic ether sets fire to those bodies and gives off thick clouds of iodine vapour. Exposed to the air at a moderate temperature it quickly breaks up into I, IO_5 and NO_5, but at a very low temperature and in a dry atmosphere it may remain unchanged for twenty-four hours. Concentrated sulphuric acid dissolves it slowly without decomposition. It is precipitated from the solution, however, when the sides of the vessel are rubbed hard with a glass rod, or when strong nitric acid is added.

Double Hyposulphates.—Dr. Kraut describes (*Archiv. der Pharm.*, Bd. clvi. s. 129) crystals of double salt $BaS_2O_6NaS_2O_6 + 4Aq.$ obtained by the spontaneous evaporation of a solution containing equivalent weights of the two salts. Crystals of the baryta salt are obtained first, then some of the soda salt, and lastly, large transparent crystals of the double salt. The crystals are permanent in the air. They have rounded angles and convex surfaces.

Another double salt $Ag\,S_2O_6NaS_2O_6 + 4Aq.$ is obtained in the first crystallization of a solution, containing equivalent weights of the two salts. The crystals appear to be isomorphous with the soda and silver salts. They effloresce over oil of vitriol, but not in the air. The author could not form double salts with the hyposulphates of many of the metals.

II. ORGANIC CHEMISTRY.

Amount of Theine in Paraguay Tea.—Rammelsberg found (*Bericht. der Akad der Wissenschaft zu Berlin*, 1861, s. 263) that benzole easily extracted the theine from Maté, or Paraguay tea. In this way he obtained 0·44 per cent., a much larger proportion than Dr. Stenhouse extracted.

Ether Formed by Fermentation.—Leuchs says (*Chem. Centralblatt*, No. 25, 1861, s. 385) that raisins, from which the greater part of the sugar has been extracted by boiling, made into balls, laid under a glass bell, and kept at 18° C. form ether, which is also produced when cotton wool, moistened with a mixture of sugar, spirit of wine and water, is placed under the same circumstances. The author says that ether is always formed when spirit of wine, sugar and water are simultaneously present in porous bodies.

Influence of Sulphur on Fermentation.—When finely-powdered sulphur is placed in grape juice, Leuchs says the fermentation goes on as usual with the formation at the same time of a good deal of sulphuretted hydrogen. If the must is not too much diluted with water, there is a smell, and even taste resembling that of garlic or onions, but when much diluted the smell is more like that of liver of sulphur. The sugar appears to be decomposed but slowly, for the fluid remains sweet a long time. Leuchs suggests that mineral waters, containing sul-

phuretted hydrogen and carbonic acid, may be prepared by fermenting with a little sulphur. Grapes which have been dusted over with sulphur to cure the disease, the author says, give wine that smells of sulphur, but loses the smell in six months, in consequence of the oxidation of the sulphur. Powdered sulphur added to a solution of grape sugar excited no fermentation in the first eight days. Afterwards the fluid became cloudy, and sulphuretted hydrogen was evolved. The fluid passed through filtering paper with great difficulty, and gum appeared to have been formed. (*Ibid.* s. 387.)

MISCELLANEOUS.

The Urine of Omnivora reduces ferricyanide of potassium to ferrocyanide, which can be shown by the addition of an iron or copper salt. It is occasioned by the uric acid in solution.—*Dr. L. C. Levoir.*

The Bessemer Process of Making Steel.—Hematite pig-iron, smelted with coke and hot-blast, has chiefly been used. The metal is melted in a reverberatory furnace, and is then run into a founder's ladle, and from thence it is transferred to the vessel in which its conversion into steel is to be effected. It is made of stout plate iron, and lined with a powdered argillaceous stone found in this neighbourhood below the coal, and known as ganister. The converting vessel is mounted on axes, which rest on stout iron standards, and by means of a wheel and handle it may be turned into any required position. There is an opening at the top for the inlet and pouring out of the metal, and at the lowest part are inserted seven fire-clay tuyeres, each having five openings in them; these openings communicate at one end with the interior of the vessel, and at the other end with a box called the tuyere box, into which a current of air from a suitable blast engine is conveyed under a pressure of about 14lb. to the square inch, a pressure more than sufficient to prevent the fluid metal from entering the tuyeres. Before commencing the first operation, the interior of the vessel is heated by coke, a blast through the tuyeres being used to urge the fire. When sufficiently heated, the vessel is turned upside down, and all the unburned coke is shaken out. The molten pig iron is then run in from the ladle before referred to; the vessel, during the pouring in of the iron, is kept in such a position that the orifices of the tuyeres are at a higher level than the surface of the metal. When all the iron has run in, the blast is turned on, and the vessel quickly moved round. The air then rushes upwards into fluid metal from each of the thirty-five small orifices of the tuyeres, producing a most violent agitation of the whole mass. The sillicum, always present in greater or less quantities in pig iron, is first attacked. It unites readily with the oxygen of the air, producing silicic acid, at the same time a small portion of the iron undergoes oxydation, hence a fluid silicate of the oxide of iron is formed, a little carbon being simultaneously eliminated. The heat is thus gradually increased until nearly the whole of the silicum is oxydised; this generally takes place in about twelve minutes from the commencement of the process. The carbon now begins to unite more freely with the oxygen of the air, producing at first a small flame, which rapidly increases, and in about three more minutes from its first appearance we have a most intense combustion going on: the metal rises higher and higher in the vessel, sometimes occupying more than double its former space. The frothy liquid now presents an enormous surface to the action of the oxygen of the air, which unites rapidly with the carbon contained in the crude iron, and produces a most intense combustion, the whole, in fact, being a perfect mixture of metal and fire. The carbon is now eliminated so rapidly as to produce a series of harmless explosions, throwing out the fluid slags in great quantities, while the union of the gases is so perfect that a voluminous white flame rushes from the mouth of the vessel, illuminating the whole building, and indicating to the practised eye the precise condition of the metal inside. The workman may thus leave off whenever the number of minutes he has been blowing and the appearance of the flame indicate the required quality of the metal. This is the mode preferred in working the process in Sweden. But here we prefer to blow the metal until the flame suddenly drops, which it does just on the approach of the metal to the condition of malleable iron: a small quantity of charcoal pig iron, containing a known quantity of carbon, is then added, and steel is produced of any desired degree of carburation, the process having occupied about twenty-eight minutes from the commencement. The vessel is then turned, and the fluid steel is run into the casting ladle, which is provided with a plug rod covered with loam: the rod passes over the top of the ladle, and works in guides on the outside of it, so that, by means of a lever handle, the workmen may move it up and down as desired. The lower part of the plug, which occupies the interior of the ladle, has fitted to its lower end a fire-clay cone, which rests in a seating of the same material let into the bottom of the ladle, thus forming a cone valve, by means of which the fluid steel is run into different sized moulds, as may be required, the stream of fluid steel being prevented by the valve plug from flowing during the movement of the casting ladle from one mould to another. By tapping the metal from below, no scoria or other extraneous floating matters are allowed to pass into the mould.

When in a closed Funnel a jet of water enters with pressure in the direction of the tangent at the largest circumference, and coal-gas enters in the direction of the axis, the gas can be lighted amidst the jet of water which revolves downwards.—*Dr. L. C. Levoir.*

Copper Smelting.—*The Ontonagon* (Lake Superior) *Miner* states that the representatives of the French company have been making investigations among the mines of the Ontonagon district in relation to the establishment of smelting works, and that the result of their investigations will undoubtedly be the early erection of such works. The fuel used will be wood. In June, the Isle Royale Mine, turned out 65 tons of copper, the Franklin 80, the Pewabic 85, the Quincy 140, and the Huron, Hancock, and Portage 22 tons, making an aggregate of 396 for the month.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Coke.—A small square box, containing two lumps of coke, was delivered by a carrier, carriage-paid, at the Editor's private address, last week. There was no name of the sender, or anything else on it, to show whence it came; and no letter has since been received which in any way refers to it.

J. A. Tring.—The metal is deposited on the pens by the electrotype process, and subsequently polished by friction. The most uniformly-successful electrotyping solutions consist of double cyanides of the metal to be deposited, with cyanide of potassium.

Nemo.—1. Mr. Leslie's address is Conduit Street, Regent Street. 2. The first patent is tenable unless the other party has previously published the principle of it. Private knowledge of it goes for nothing.

A Poor Chemist's favourable opinion has been received by the Editor with much pleasure.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Colour-tests for Strychnia and the Diagnosis of the Alkaloids,[1] *by* WILLIAM A. GUY, *M.B. Cantab. Fellow of the College, and Professor of Forensic Medicine, King's College, London.*

(Continued from vol. iii. p. 303.)

THE last of the four questions proposed for solution in my first communication still remains to be discussed. It relates to the diagnosis of the alkaloids, and was expressed in the following terms:—Is it possible by means of the colour-tests, or by any simple modification of them, to distinguish the alkaloids from each other?

Before proceeding to examine this question I must briefly refer to what I have already stated respecting the colour-tests. These tests, as commonly understood, are compound tests, consisting first of the reaction of the alkaloid with sulphuric acid, and then of the reaction of the peroxides of lead and manganese, the bichromate of potash, the ferricyanide of potassium, and the permanganate of potash, with the mixture of the alkaloid and sulphuric acid.

The sulphuric acid produces in strychnia no change of colour. Hence the acid itself becomes a test of no mean value. It serves, as I shall point out more particularly presently, to distinguish strychnia from a considerable number of the alkaloids, and also from several substances which give with sulphuric acid alone coloured reactions, some of which reactions with the acid alone bear a certain resemblance to those of strychnia with sulphuric acid *plus* the bichromate of potash, ferricyanide of potassium, permanganate of potash, peroxide of lead, or peroxide of manganese. In order to distinguish strychnia from other alkaloids, and from the substances to which I have just referred, it is essential that the sulphuric acid should be first applied to, and well mixed with, the strychnia, and that the absence of colour having been noted, the reagents that develope the colour should be in their turn applied. In all that I have said on the subject of the colour-tests for strychnia, and in what I have yet to say, I assume this mode of procedure to be strictly observed; and I shall continue to speak of these reagents as the colour-producing tests.

I have hitherto assumed that the sulphuric acid is applied cold; but I shall presently point out that we may greatly add to the value of this constituent portion of the colour-tests by first warming and then heating the acid solution. A very slight rise of temperature serves to develope very beautiful and characteristic colours in some of the alkaloids, while it does not change the colour of strychnia. A further rise of temperature to the point of causing the mixture to give off vapour, developes colour in strychnia also, and deepens or changes the tints already imparted to the alkaloids previously affected by warming the acid mixture.

The colour imparted to a solution of strychnia in sulphuric acid by raising it to a temperature at which it gives off vapour is not strongly marked. It is a faint yellow or light greenish-brown, differing somewhat in depth of tint with different specimens of strychnia treated in all respects exactly alike. If the acid solution is allowed to cool it no longer acts characteristically with the bichromate of potash or the other tests. Their action is wholly destroyed or greatly impaired. Hence in applying the colour-tests for strychnia, we must use concentrated pure sulphuric acid, and use it cold.

So much for the first part of the colour-tests. We add to the alkaloid under examination sulphuric acid in small quantity—pure, strong, and cold; and it undergoes no change of colour. The alkaloid, therefore, whatever it may be, belongs to the class of which strychnia is one.

To this cold acid solution of the alkaloid we add a minute fragment of bichromate of potash, ferricyanide of potassium, permanganate of potash, peroxide of lead, or peroxide of manganese. The result is the remarkable development of successive transient, or short-lived, colours already described.

The negative reaction of strong cold sulphuric acid on strychnia, followed by the effect of heat on the acid mixture, and this by the peculiar colours produced by the application of the colour-developing substances to the cold acid mixture, constitute a series of phenomena which afford fair promise of proving the means of a successful diagnosis of the alkaloids.

To this work of distinction I now address myself, and in order to prepare the way more completely for the work of tabular analysis towards which the details given in my former communications have been tending, I must again revert to the question whether the action of the colour-tests on strychnia is, or is not, characteristic, and therefore, diagnostic.

This is a question which must have suggested itself to every chemist engaged in medico-legal inquiries as of the utmost practical importance, and one chemist (Mr. Thomas E. Jenkins) having been employed to investigate a case of suspected poisoning, in which the colour-tests gave indications of the presence of strychnia, very properly put the question to the test of experiment, by applying to a variety of active principles, including most of the alkaloids, first, colourless concentrated sulphuric acid, and then a fragment of a crystal of bichromate of potash. The experiments, which were carefully performed, and appear to have been strictly comparable one with another, embraced no less than fifty alkaloids and active principles, derived from the animal as well as the vegetable kingdom, and among them, urea and uric acid, and cantharidine. More than half of these substances differed from strychnia in yielding colour when treated with sulphuric acid. The smaller half resembled strychnia in this respect. But not one of the whole

[1] Substance of part of the Croonian Lectures for 1861, delivered at the Royal College of Physicians; from the *Pharmaceutical Journal.*

fifty gave with the bichromate of potash the characteristic coloured reactions of strychnia. Feeling that my time would not be wasted in repeating his experiments, and, if possible, extending them to substances not included in his list, I possessed myself (partly by the kind assistance of Mr. Morson) of all the alkaloids and similar active principles which could be obtained, and tested them in the same way. To Mr. Jenkins' list, some of which I was not able to procure, I succeeded in adding as many as sixteen new substances. None of these gave the characteristic coloured reactions of strychnia, nor any succession of colours any way resembling them, so that I am now in a condition to assert that strychnia stands alone among sixty-six analogous compounds in the reactions which it gives with sulphuric acid followed by the bichromate of potash.

Mr. Jenkins (as will be seen in the table published by him in the CHEMICAL NEWS for October 6, 1860) arranges his reactions in two columns. The first column displays the effect produced by strong sulphuric acid; the second, the changes of colour caused by the addition to the acid solution of the bichromate of potash.

Now this table affords an excellent illustration of the absence of method and logical arrangement. The substances operated on evidently took their places as they chanced to come to hand. Strychnia itself has to be sought out; and substances which give coloured reactions with sulphuric acid, find themselves in contact with others that give a negative result.

And yet the table seems to court the attention of lovers of method and logical order. It is almost impossible to keep one's hands off it. At least, one would like to place the substances which are not coloured by sulphuric acid by themselves, and those that are coloured also by themselves. I have undertaken this work of tabulation, and, on inspecting the result, am seized with the same desire to resume the work of arrangement. In both groups there are substances which yield with bichromate of potash the same colours. Why should not these similar reactions be bracketed together? This, accordingly, I have carried into effect, and the result is a splitting up of the fifty substances into several groups of such moderate dimensions, that a man given to tabular analysis can scarcely resist the additional temptation to try whether some modification of the tests themselves, or some additional tests, or both together, may not lead to a successful separation and elimination of each and all the substances contained in the table.[2] I now proceed to lay before you in a tabular form the results of a very laborious experimental attempt to distinguish some of the principal alkaloids and active principles, whether derived from the vegetable or animal kingdom, from each other.

As the first object which I had in view was to distinguish the poisonous alkaloids and analogous active principles from each other, these substances are of course admitted into the tables; but I have added to these the active principles of many of our aperient medicines and common articles of diet; and have excluded only such of those substances as were so strongly characterised by colour or odour, as not to be properly grouped with the colourless, or faintly-coloured, and inodorous alkaloids and active principles.[3] The table, divided for convenience into two, consists, as it is, of as many as thirty-five different substances, closely resembling each other in physical properties and chemical composition, and offering collectively a very difficult subject for tabular analysis. The tables, as you have them before you, are the result of a long series of experiments, and were only made to assume their present form after a great many experimental groupings and transpositions.

The first object which I had in view was to find some simple test which would divide the whole body of active principles comprised in the two tables into two principal groups. Concentrated sulphuric acid, as a constituent of the strychnia colour-tests, was obviously well adapted to this purpose. It has the effect of dissolving the alkaloids and active principles without change of colour in the case of one considerable group (Table I.), and with change of colour in the case of another considerable group (Table II). The first group (Table I.) comprises the majority of the active poisonous principles—strychnia, brucia, morphia; atropine, picrotoxia, aconitina; and the animal principle cantharadine. With these and several other alkaloids and active principles, some of which are very harmless ones, concentrated sulphuric acid either produces no change of colour, or a faint yellow, straw, or buff tint.[4] I speak of cold concentrated sulphuric acid, applied as in the preliminary to the colour-tests for strychnia.

The next object which I had in view was to subdivide these two large groups (Tables I. and II.) each into two or more smaller groups by some second test, which might also, perchance, produce in some members of the two groups characteristic reactions, so as to eliminate or separate them at once. For this purpose I tried the effect of warming the acid solution of the alkaloids by passing the porcelain slab through the flame of the spirit lamp, so as to raise the temperature of the liquid to a point short of that at which it gives off vapour. This subsidiary test answered its purpose completely; the group of substances in Table II. which had already given colours, more or less characteristic, with the cold acid, underwent further changes of colour more or less peculiar; while the group in Table I. which had undergone no change with the cold acid, became subdivided into two leading groups, of which one continued without colour, and the other underwent changes of colour more or less characteristic. In the instances of meconine and of aconitina, the colours developed proved to be peculiar to these substances, so as to lead at once to their elimination from the rest.

By raising still further the temperature of the acid solutions to a point at which vapour was given off, a further separation into distinct groups or classes was

[2] In the lectures given at the College of Physicians, Mr. Jenkins's original table, and the two tabular arrangements alluded to in the text, were sent round. These tables were the more freely used as illustrations of a want of logical arrangement, as the author evidently did not aim at diagnosis, but only at the distinct ascertainment of the peculiar and characteristic reactions of strychnia. The remarks in the text were not, therefore, intended in any respect as a censure of Mr. Jenkins for not adopting an arrangement which, for his purpose, was unnecessary. I may add, that his table comprises several substances which will not be found in the tables I am about to submit. I mean such substances as the klnic and kinovic acids, and such animal products as urea and uric acid.

[3] To this statement it will be seen that there are one or two exceptions, such as naphthaline, which, though colourless, has the odour of tar.

[4] I ought to state in this place that some of the alkaloids are very sensitive to heat, so that a very slight rise of temperature is followed by a decided development of colour. Hence it is possible that experiments made in a cold room in winter may yield results differing somewhat from the same experiments made in a warm room in the height of summer. It must also be borne in mind that sulphuric acid, if not free from nitric acid, may impart to some of the alkaloids a tint of rose, yellow, or buff, sufficiently deep to justify their removal from Table I. to Table II. It may be well, therefore, to state that the experiments on which the tables are founded were made in the winter, in a room with a fire, but in the morning, before the temperature of the room had been raised to a point approaching summer-heat; and that the acid employed was free from nitric acid.

found to take place. The six substances which stand first in order in Table I. still remained colourless, while the remainder assumed tints more or less characteristic. Esculine and atropine; picrotoxia, santonine, and narcotine; amygdaline and naphthaline, formed themselves into three distinct groups; while strychnia, brucia, and morphia gave indications of colour less distinct and characteristic.

By this triple test of sulphuric acid—cold, warmed, and heated—the active principles contained in this division (Table I.) have been either eliminated, or split up into manageable groups, awaiting the application of further tests. It seemed natural to select as the next test in order nitric acid—a known characteristic test of brucia and morphia. By applying this test to the several members of the table in succession, codia was isolated from the group of six to which it belonged by the distinct yellow colour assumed by the acid solution. Emetine was, in like manner, isolated from the other members of the same group of six, by yielding with the acid a yellow-brown colour. Atropine, again, was distinguished from esculine by giving a negative result, while esculine assumed a distinct yellow colour. In the same way narcotine was detached from its group of three, and naphthaline from its group of two. Again, morphia was distinguished by the rich orange hue given by the acid, together with the red fumes of nitrous acid; and brucia was effectually distinguished from strychnia by the intense red of the former contrasting with the faint tinge of red imparted to ordinary specimens of the latter. For the next eliminating test I have selected sulphuric acid followed by a solution of permanganate of potash, in the proportion of 10 grains of the salt to ℥j. of water The effect of this test on strychnia was to develope its characteristic colours, strongly contrasted with the altogether different colours given with brucia, and still more with the brown colour imparted to morphia, followed by the bleaching of the liquid. This same test divided the somewhat unmanageable group of four at the top of the table (cantharadine and asparagine, and caffeine and cinchonine) into two small groups of two each. In the first two the immediate effect of the permanganate was a red-brown colour; in the second, a pink. Picrotoxia and santonine gave the same colour (pink) and remained undistinguished. The last and ultimate work of elimination was effected by means of heat applied to the active principle in its solid state. Cantharadine was found to be wholly dissipated by the heat of the spirit lamp, while asparagine gave a bulky carbonaceous deposit. And caffeine was found to present the same difference when compared with cinchonine. Lastly, picrotoxia was found to be distinguished from santonine by the bulky carbonaceous residue with the first, and the scanty deposit of carbon with the second.

Having by this succession of tests obtained a clue to the active principle with which we have been dealing, we should proceed to identify the substance indicated by the table, through its own characteristic tests.

In the second division of the one large table of elimination, or that which comprises active principles coloured by contact with cold sulphuric acid (Table II.), the same succession of tests is employed. Cold concentrated sulphuric acid at once separates this group of seventeen into eight smaller groups of one, two, or six; and the subsequent warming and heating of the coloured acid solutions occasions such marked differences of colour as to nearly complete the work of elimination. But I have added columns showing the effect of nitric acid, and of the solution of permanganate of potash. The application of heat to the alkaloids themselves did not prove necessary to the work of elimination.

I submit these tables primarily as specimens of Tables of Elimination; but also incidentally as tables which may prove serviceable to the chemist. I am not certain that they constitute the best aid which could be devised to the diagnosis of the alkaloids. I thought that they might, perhaps, admit of being simplified by adding to the three columns headed "sulphuric acid" a fourth, showing the deposit of carbon resulting from the continued application of heat to the acid solution of the alkaloid. I tried this reaction in the case of fourteen alkaloids and active principles, comprising all the more active poisons of this class, together with the less important principles, emetine and meconine, and found the alkaloids to differ from each other in the amount of carbonaceous deposit. With strychnia, aconitina, and veratria, for instance, the deposit of carbon was less abundant than with brucia, morphia, atropia, and the other poisonous alkaloids. But the difference was not such as to justify me in using it as a diagnostic property. So also with the direct application of heat to the alkaloids themselves. Strychnia, morphia, atropia, cantharadine, meconine, picrotoxia, and delphinia, after melting, deposited but a scanty carbonaceous ash; while emetine, aconitina, and digitaline yielded an abundant ash; and brucia, elaterine, veratria, and solanine yielded an ash intermediate in quantity. This test, again, though fairly applicable to the few cases in Table I., did not seem admissible as a diagnostic on a larger scale. Indeed, the tables, though carefully compiled and based on carefully-conducted experiments, are open to the obvious objection that, with different specimens and different quantities of the alkaloids, and with different specimens of sulphuric acid, we may obtain differences of tint, and more or less ready development of colour under increase of temperature. The majority of the reactions, however, will, I believe, be found constant for all specimens of fair average purity. One

TABLE I.

Alkaloids, &c., giving no Colour with Cold Sulphuric Acid.

Alkaloids, &c.	Sulphuric Acid.			Nitric Acid.	Sulphuric Acid, followed by the Solution of Permanganate of Potash.	Heat.
	Cold.	Warm.	Hot.			
Cantharadine .	o	o	o	o	Red brown	o
Asparagine . .	o	o	o	o	Red brown	Carbon[3]
Caffeine & Theine	o	o	o	o	Pink	o
Cinchonine . .	o	o	o	o	Pink	Carbon[3]
Codia	o	o	o	Yellow		
Emetine . . .	o	o	o	Yellow-brown		
Strychnia . .	o	o	Yellow[1]	Pink[1]	Blue, Mulberry, Orange	
Brucia . . .	o	o	Yellow[2]	Red[3]	Red, Brown, Orange, Yellow	
Morphia . . .	o	o	Brown	Orange[3]	Brown, then bleached	
Esculine . . .	o	o	Brown[3]	Yellow		
Atropine . . .	o	o	Brown[3]	o		
Meconine . .	o	Blue				
Aconitina . .	o	Brown				
Picrotoxia . .	o	Yellow	Brown	o	Pink	Carbon[3]
Santonine . .	o	Yellow	Brown	o	Pink	Carbon[1]
Narcotine . .	o	Yellow	Claret	Yellow		
Amygdaline .	o	Pink	Brown	o		
Naphthaline .	o	Pink	Brown	Yellow		

alkaloid, hyosciamia, which I was not able to procure, is omitted.[5]

TABLE II.

Alkaloids, &c., giving Colour with Cold Sulphuric Acid.

Alkaloids, &c.	Sulphuric Acid.			Nitric Acid.	Sulphuric Acid, followed by the solution of the Permanganate of Potash.
	Cold.	Warm.	Hot.		
Veratria	Orange[3]	Scarlet	Claret	o	
Piperine	Orange[3]	Red-brn.	Green[3]	Orange[3]	
Delphinia	Pink[1]	Pink[3]	Brown	o	Yellow[1]
Salicine	Pink[1]	Pink[3]	Claret	o	Claret
Digitaline	Red-brn.[1]	Red-brn.[2]	Red-brn.[3]	o	Buff
Elaterine	Red-brn.[1]	Red-brn.[2]	Red-brn.[3]	o	Pink[3]
Papaverine	Purple[3]	Purple[2]	Purple[1]	Yellow	Green; slate
Paramorphia	Purple[1]	Purple[1]	Purple[3]	Yellow	Green; brown
Quina	Yellow	Yellow	Yell.-brn.	Yellow	
Aleine	Yellow	Yellow[3]	Green	Orange	
Jalapine	Yellow	Orange[3]	Red-brn.	Yellow	
Narceine	Yellow	Red-brn.[3]	Red-brn.[3]	Green-brn.[3]	Buff
Phloridzin	Yellow	Red-brn.[3]	Red-brn.[3]	Red-brn.[3]	Pink[3]
Solania	Yellow[3]	Brown[2]	Brown[3]	o	
Cubebine	Pink[3]			Yellow	
Quinoidin	Brown	Brown	Brown	o	
Sanguinarine	Red-brn.[2]	Claret	Claret	Red-brn.[2]	

Of the two tables, Table I. affords the best illustration of a table of elimination. For the sake of brevity, and for other reasons already explained, the figures 1, 2, 3, are added to the words describing the colours developed by the tests. These figures indicate different degrees of intensity. In comparing strychnia with brucia, for instance, the figure ([1]) attached to the word "yellow" opposite strychnia in the third column means a faint yellow colour, less in degree than that indicated by the figure ([2]) opposite brucia in the same column. So the word "brown" with the annex [3] in the same column opposite esculine and atropine indicates an intense brown colour; the words red [3] and orange [3] in the column headed nitric acid indicate intense red and orange respectively.

On some Combinations of Selenium Analogous to Sulphides, by M. H. UELSMANN.

Selenide of Arsenic, $AsSe_3$, deposits itself as a brilliant dark brown powder, when seleniuretted hydrogen is passed into a solution of arsenious acid, slightly acidulated with hydrochloric acid. The seleniuretted hydrogen was prepared by M. Wöhler's process, which consists in making pure, dry, and warm hydrogen act on selenium. Selenide of arsenic melts at 200°, forming a black liquid, which, when cold, forms an amorphous mass, with conchoidal fracture. It is soluble in alkalies, and colours the solution red-brown; nitric acid also dissolves it.

By melting together equal equivalents of arsenic and selenium, a shining, black, amorphous mass, with conchoidal fracture, is formed, soluble in caustic soda by the aid of heat, and yielding a brown-red liquid, and depositing itself from this solution in brilliant, bronze-coloured scales. This body appears to be $AsSe_6$.

Selenide of Antimony, $SbSe_3$, obtained by precipitating a solution of tartar emetic by seleniuretted hydrogen, it is a black powder, which, when heated to 146°, suddenly becomes gray. At a red heat it melts into a black liquid, which becomes a granular, crystalline mass. It is soluble by heating in caustic potash, giving it a yellow-brown colour.

Selenide of Tin.—Protoselenide, SnSe, is formed by precipitating a solution of protochloride of tin by seleniuretted hydrogen. It is a brown powder, black when dry, easily soluble in caustic alkalies and in alkaline sulphides, and is neither fusible nor decomposable when heated in a glass tube in an atmosphere of hydrogen.

The same combination is produced with incandescence by heating three parts of tin and four of selenium in a current of carbonic acid. It forms a gray, crystalline, readily-clearable mass, with metallic lustre.

Biselenide of Tin, $SnSe_2$, obtained by means of bichloride of tin and seleniuretted hydrogen, is a dark, yellow-orange coloured powder, clear red-brown when dry. By heating in a current by hydrogen, this selenide loses half its selenium and becomes protoselenide. It is soluble in caustic and sulphuretted alkalies; the solutions deposit selenium when exposed to the air.

Selenide of Tungsten, WSe_3.—A solution of tungstate of soda, saturated with seleniuretted hydrogen, has a brown-red colour. Diluted sulphuric acid precipitates black selenide of tungsten from it, with disengagement of seleniuretted hydrogen. Selenide of tungsten is soluble in caustic alkalies and in alkaline sulphides and selenides.

Selenide of Molybdenum is similarly produced, but it is impure through the presence of a bluish-gray combination.

Selenide of Bismuth, $BiSe_3$, is black. It forms, when melted, a metallic-looking button. It is precipitated when a limpid solution of bismuth, with as little acid as possible, is treated by seleniuretted hydrogen. It is soluble in nitric acid, but resists caustic alkalies and alkaline sulphides.

Selenide of Gold, $AuSe_3$, is produced by passing seleniuretted hydrogen into chloride of gold in the dark. It is black, and decomposable by heat and by nitric acid.

Selenide of Mercury.—The selenide HgSe is obtained by direct combination, whatever proportions are employed. The combination is effected with hissing sound. At a high temperature the selenide is gaseous, and condenses into brilliant crystals, of a steel-gray colour, with black powder.

By directing a current of seleniuretted hydrogen through a solution of bichloride of mercury, a white precipitate is first produced, containing $2HgSe + HgCl$. Nitric acid does not attack this combination. Caustic soda transforms it into $2HgSe + HgO$.

Selenide of Cadmium, CdSe, prepared by chloride of cadmium and seleniuretted hydrogen, forms a brown powder, decomposable by hydrochloric acid, with disengagement of seleniuretted hydrogen.

Selenide of Sodium.—Sodium and selenium unite with ignition when heated, forming colourless selenide of sodium. By passing seleniuretted hydrogen into a solution of caustic soda, it assumes the form of a crystalline mass. When the mass is heated, while a current of hydrogen traverses it, the selenide dissolves, and on cooling deposits long, flat crystals. It becomes red and hot in the air.—*Annalen der Chemie und Pharmacie,* vol. cxvi., p. 122.

[5] In the lectures at the College of Physicians a table was used which shewed the colours actually produced by the action of the several re-agents on these poisonous alkaloids and active principles.

TECHNICAL CHEMISTRY.

On the Occurrence of Soluble Compounds of Copper, Lead, and Tin in Newly-distilled Alcoholic Spirits, by Dr. A. A. Hayes.

In an article discussing the question of the existence of poisonous bodies, especially strychnine, in the spirits produced from grain, which has been so frequently agitated by the public journals during the past few years, Dr. A. A. Hayes expresses his conviction that no good reason can be found for the statements affirming the existence of such substances, which have been made by the newspapers; and remarks that his opinion is founded not only upon an extensive series of analytical observations, but is supported by the testimony of the parties most likely to know of such adulteration if it were really made, none of whom had ever met with a case at the places of manufacture which would lead even to an inference that any deleterious body had been purposely added to the distilled spirits.

But while dismissing this bugbear, Dr. Hayes calls attention to another source of danger which may be of importance. "Newly-distilled spirits, of the most common kind often contain salts of copper, of lead, or tin derived from the condensers, in which the vapours are reduced to a fluid form. The quantity of copper salt contained in the bulk usually taken at a draught, is sufficient to produce the minor effects of metallic poisoning; the cumulative character of these poisons may even lead to fatal consequences. With a knowledge of the fact now stated, instead of resting on a supposition of the existence of an organic poison in the spirit, which may have caused sickness, the physician should notice the symptoms of metallic poisoning in persons addicted to the habit of consuming newly-distilled spirits, and interpose his aid in preventing the fatal termination of vicious indulgence."

The author goes on to remark, that since he first became aware of the frequent occurrence of these metallic salts in recently manufactured spirits, he has made investigations which "prove that as all spirits at one time were new, so with few exceptions—arising from peculiar rectifications—most spirits have been, or are, more or less, contaminated by metallic compounds. Old or more matured spirits have generally lost every particle of the salts once held in solution. Changes in the organic solvent have caused the deposition of the metallic compound accompanied by the organic matter from obvious sources and in such spirits the metallic oxide is always found—if it has been present—in the dark coloured matter which has been deposited at the bottom of a cask at rest. This dark deposit has the appearance of, and has been mistaken for, charcoal, detached from the charcoal staves of the casks in which the spirits have been stored. Of this dark deposit every sample has, on examination, afforded abundance of copper, copper and tin, or copper and lead, even when taken from the finer qualities of foreign spirits. Observations have been made on the nature of this change from a soluble to an insoluble state. Samples of new spirits have been kept in glass vessels until the whole metallic salt has fallen in dark flocks, leaving the clear fluid free from any metallic compound and perfectly pure. It appears, therefore, that matured spirits lose their poisonous impregnation during the time necessary to adapt them for use as beverages, and that while the clear, transparent fluid contains no metallic impregnation, a turbid though ripened spirit may prove deleterious, through its suspended metallic compounds. In order to avoid the poisonous effects of these salts, perfectly well-ripened and clear spirits only should be used in the preparation of medicines, and when ordered as restoratives, no new or turbid alcoholic fluids should be allowed to enter the hospital or room of the patient."

Dr. Hayes explains the origin of these salts as being connected with the production of acids, as well as alcohol in the fermenting vats. "When the wort is subjected to heat in the still, acetic, butyric and other acids rise with the vapour of alcohol, and pass into the condenser, now most commonly made of copper, with masses of solder containing lead. At the instant of condensation, these acids exert a power of corrosion on the metals quite unsuspected, and the salts formed dissolve in the spirit. Where condensers of pure tin are used, no copper salt is formed, and a little tin salt takes place. With the vapour of dilute alcohol some vesicular vapour of the wort is carried forward, and the dextrine which can be found in the spirit; another portion of soluble organic matter is abstracted from the wood of the cask, and this is often tannic acid. In the subsequent chemical changes these organic compounds unite with the salts, and fall in the form of a sub-granular dark matter seen in colourless spirits of all kinds. In detecting the metals held in solution, the extract obtained, after evaporating the spirit, must be destroyed, as usual in toxicological testing, and an acid solution of the oxide obtained; or the extract may at once be mixed with carbonate of soda, and the metal reduced by the blowpipe flame. When the deposit is the subject of trial the metal or metals appear on fluxing with carbonate of soda, in the inner flame produced by the blowpipe, on charcoal.—*Boston Medical and Surgical Journal*, lxiii. 169.

PHARMACY, TOXICOLOGY, &c.

On Liquor Ferri Iodidi, by W. J. M. Gordon, *Cincinnati.*

Newly-prepared syrup of iodide of iron, according to the United States Pharmacopœia, is a transparent liquor of a pale green colour, but frequently becomes a dark red. If exposed to the direct light of the sun, it is restored to its original transparency and colour. The same change will take place if exposed to the indirect light, but requires a much longer time. The loss of colour by the action of light distinguishes the syrup from a watery solution of the iodide of iron, which, if exposed to light, undergoes continual decomposition, becoming darker and darker. The inference is very clear, that the deoxidising influence of the sugar, which is so well known, protracts the decomposition; but the darkening of the syrup continues if the light is excluded, and to the light must be attributed a great influence on the changes going on in the syrup. To ascertain what these changes are, the following experiments have been made:—

1. A dark syrup was filtered; the filtered liquid was clear, of a reddish-brown colour, and contained free iodine, as a test with starch clearly showed. On the filter remained a deposit, which, after being well washed, dried, and heated, smelled strongly of iodine, and left oxide of iron. The solution of this deposit in nitric acid, after an addition of starch, became blue.

2. Some of the dark syrup was exposed to the direct

light of the sun, filtered after it had assumed a light green colour, and the well-washed deposit on the filter was found to be oxide of iron, entirely free from iodine, and in the syrup there was no longer any free iodine, as a test of starch showed.

3. Fifteen grains of iodide of iron and one ounce of water were put in two white bottles; these were exposed to the sunlight; in both of them the liquid soon became turbid, and assumed a red colour, caused by free iodine. To one of the bottles was then added a small quantity of sugar, and its contents became almost immediately nearly colourless and clear, depositing sediment of oxide of iron, while the liquid in the other bottle was constantly becoming darker, and seemed to be entirely decomposed.

From these experiments, the following conclusions have been arrived at. In the dark syrup a combination of iodide of iron is suspended, and free iodine dissolved in it. In the syrup decolorised by the light there is no longer any free iodine dissolved in it, but it contains a sediment of oxide of iron. The sediment in a watery solution of iodide of iron, according to Berzelius, is an oxyiodide of iron, probably $Fe_2 I_3 + Fe_2 O_3$. The following will explain this: $4 Fe I + 3 O$, form in the dark $Fe_2 I_3 + Fe_2 O_3 + I$.

As experiment No. 2 shows, the oxyiodide is decomposed by exposure to the light, the sediment no longer contains any iodine, and the proto-iodide of iron again formed $Fe_2 I_3 +$ and $Fe_2 O_3 + 2 I$. But this iodine, which, according to the formula, is free, can no longer be tested by starch, and the principal purpose of this examination was to ascertain what had become of it. The most simple explanation is, that hydriodic acid had been formed. To test for the hydriodic acid, about one pound of the decolorised syrup was put in a glass retort, and heat applied until half-an-ounce was distilled over. This liquid was found to be a watery solution of hydriodic acid. Nitrate of silver produced a yellow precipitate of iodide of silver, and starch became blue upon the addition of chlorine water.

A solution of iodine in sugar and water, in which iodine is more soluble than in water, has a dark red colour; sun-light changes it to white, and no free iodine can be found in the decolorised liquid, and all reactions show that the iodine is changed into hydriodic acid. The same change takes place in an alcoholic solution of iodine, and in a watery solution of iodine in iodide of potassium. The process given above is a very easy and simple one for testing syrup of iodide of iron for hydriodic acid. How far the medicinal properties of the syrup are affected can only be determined by the careful observation of physicians; but it is obvious that a dark syrup should never be used, in consequence of its containing free iodine.

PHYSICAL SCIENCE.

On the Property possessed by Platinum rendered Incandescent by the Battery to produce Gaseous Combination, by M. E. Saint-Edme.

I will first draw attention to the sensibility of iodised starched paper, as a re-agent for oxygenised compounds of nitrogen, hyponitric, and nitric acid, infinitely minute traces of which existing in a medium sufficing to blue very decidedly the iodised starched paper.

M. Leroux's experiment, which consists in obtaining ozone by passing a current of air on a platinum wire, made red hot by electricity, has led me to examine whether oxygen alone could be modified under the same conditions. I find that pure oxygen passing in contact with a spiral, rendered incandescent by an electric current, has no effect on iodised starched paper, and consequently does not seem to be modified. If, on the contrary, oxygen and nitrogen are made simultaneously to impinge on the red spiral, the issuing gas strongly colours iodised starched paper blue, and litmus paper red; hence, I conclude, that under these conditions nitric acid is formed. I am about to continue these researches with various gases.—*Comptes-Rendus.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 20, 1861.

W. De la Rue, *Esq., in the Chair.*

Two Papers by Mr. Vernon Harcourt were read "*On the Peroxides of the Alkaline Metals,*" and "*On the Estimation of Nitric Acid;*" and one by Dr. Marcet, "*On the Constituents of Gastric Juice.*"

Dr. Roscoe then delivered the following discourse "*On the Application of the Induction Coil to Steinheil's Apparatus for Spectrum Anlaysis*":—

It is not possible for me this evening to deliver a formal discourse on the subject of the application of spectrum observations to chemical analysis, because the time which has elapsed since the first discovery of this new mode of detecting the elementary bodies is so short, that we are as yet incompletely acquainted with either the power or the capabilities of the valuable instrument which we propose to employ; but I do not know that I need apologise to the Fellows of the Chemical Society for bringing before their notice any new facts, however incomplete, that may at all serve to illustrate the progress of this new and most interesting branch of our science.

It would be unfitting were I here to enter into details or to give the result of the application of the method of spectrum analysis to the detection of the metals of the alkalies and alkaline earths. All of us must have read the important papers of Bunsen and Kirchhoff with a great deal of interest. What I propose to do this evening is to lay before you the method which the German professors intend to employ for the purpose of applying this method of research, not merely to the metals of the alkalies, or the alkaline earths, but to all the metals—we may hope so—and I think our hope is well-founded, and to the non-metallic bodies as well.

Before, however, I pass to the main subject, there are one or two points connected with the application of this method for the detection of the alkalies and alkaline earths, which, as they are of general importance, it may be well to mention.

In the first place, the property which incandescent bodies possess of giving spectra consisting of bright lines depends upon the substance being in the gaseous form. The spectra of luminous gases are broken; those of luminous solid bodies are continuous. In the gaseous state a heated body between certain given limits emits only a few kinds of light of different degrees of refrangibility; whereas a solid body, when heated, emits, between the same limits, rays of every degree of refrangibility. In order, then, that the peculiar spectrum of any substance may be formed, the incandescent substance must be in a gaseous state. It must be exposed to a temperature at which the tension of its vapour is appreciable. The greater the amount of its incandescent vapour present in the unit of space—that is, the higher the temperature or the more volatile the substance, the

greater does the intensity of the spectrum appear. Kirchhoff and Bunsen showed in the first place in their paper to which I have referred, that all the volatile compounds of a given metal produce the same bright lines; that these bright lines may be taken as certain indications of the presence of the metal, and that from the absence of such bright lines we may conclude the absence of any salt of the metal which is volatile at the temperature of the experiment.

They likewise showed that the range of the temperature within which these bright lines produced by any given metal remained constant is extremely large. The lines are produced by heating a body by the flame of sulphur, of which the temperature is only 1820°; and that produced by heating by the oxyhydrogen flame, in which the temperature is calculated to be above 8000°; and that produced, also, when an electric spark is allowed to pass from the poles of the metal in question, the temperature of the electric spark being vastly higher than the oxyhydrogen flame. Through these very different ranges of temperature we find we get exactly the same character of lines, that these lines remain fixed and show exactly the same relative position at a high and at a low temperature; and with perhaps the exception of the combining weights, there is no other single property of the metallic elements which remains so constant and serves so well to distinguish the metallic bodies through so wide a range of temperature as this property of the production of certain bright lines in their spectra;—this power of the vapour of metallic compounds to give off certain rays of a definite refrangibility. On the extraordinary delicacy of this investigation and the unlimited field which is opened out by inquiry, I need not now speak. The apparatus which was figured in Bunsen and Kirchhoff's paper has been superseded since that time by one more convenient, and which is in many respects more useful. I have here several of the apparatus—one made in Germany, one kindly lent by Dr. Faraday, and one made on the model of this by Mr. Ladd. These two instruments are made by Steinholt, of Munich. They possess the advantage of being first rate pieces of optical workmanship, the Munich prisms being of world-wide celebrity; and then they possess the other advantages of being more easily moveable and being more firmly fixed. The heavy iron stand renders the thing more secure. The great advantage, however, of this mode of arrangement is the fact that we can use two spectra from two flames; for the back of the slit carries a small prism, which is placed over the upper half of the slit in such a position that the light from one flame, which we place at the side, can fall upon the small prism and be refracted through the prism in this direction parallel to the axis of this tube; so that in that way we get one image from the flame on the right, which passes through the upper half of the slit, and is seen in the lower half of the field here, because this telescope reverses it; and we get, in the second place, the light from the lamp on the left also, passing into the telescope and through the lower uncovered half of the slit. This is particularly useful, of course, when we have to detect any given substance. If we are looking for lithium, for instance, and are not sure of its presence, we have but to place a piece of a lithium compound in, and we at once see whether the two lines exactly coincide. If they do not, we know there is no lithium present. If the coincidence is perfect, if the red line passes at once all through, then we are quite sure that lithium is present in the body which is undergoing investigation. These apparatus, however, are very useful, inasmuch as the breadth of the slit can be altered at pleasure, and, owing to the accurate workmanship, we can see the double line "D" of the solar spectrum, and the soda line is easily distinguished as double, and we may also see the lines of which I shall have myself afterwards to speak.

In referring to these diagrams of the spectra of the alkalies and alkaline earths, I would only remark that these diagrams are given by Kirchhoff and Bunsen, not as accurate representations of what we absolutely see with a good instrument when we pass one of these substances in the flame. Bunsen distinctly states in his paper that these lines were drawn so that only the most distinct lines should be seen. These are not intended to give the absolute representation, but to give such a representation as may be most easily applicable for the purpose of chemical analysis. If we were to represent all the lines which are seen, it would be much more complicated. And Bunsen very wisely thought it would be best to take such a breadth of slip that only the most important lines of the solar spectrum, and in the spectra of the alkaline metals, should be visible. I ought also to mention that Bunsen and Kirchhoff were by no means the first to observe the particular lines of metals. In their paper they begin by saying it is well known that certain bodies when placed in a flame produce spectra containing brightly-coloured bands. They were acquainted with the researches that had gone before. I have their own authority for saying this. In our own country, Talbot, and Wheatstone, and Dr. Miller observed closely the same thing; at all events, they observed some of the points which were noted by Bunsen and Kirchhoff, but to Bunsen and Kirchhoff belongs the honour of having first brought the subject to a definite issue, and made it a distinct and prominent branch of chemical analysis. The most interesting point so far as we yet know regarding the discoveries which have been made by this method, is, of course, the discovery of the two new alkaline metals. The first of these, cæsium, was discovered in the springs of Dürkheim and Baden; and he found that most of the springs containing chloride of sodium also contained this cæsium. It is very widely distributed in most springs containing chloride of sodium. In forty tons of this Dürkheim water, he obtained only five grammes of cæsium. The atomic weight of cæsium is 123·4. An extremely high atomic weight, and one which bears no relation to the atomic weights of the other alkaline metals, lithium, sodium, and potassium, which have a common difference of sixteen. The same common difference does not exist in the case of cæsium. The chloride is soluble, and deliquesces in the air; the sulphate is anhydrous, and so soluble that one part of water at 20° Centigrade dissolves one and a-half of the salt. Water at the same temperature dissolves only about one half its weight of the sodium sulphate. The nitrate crystallizes, and is also anhydrous; the salt crystallizes in the hexagonal system, and is therefore isomorphous. The carbonate of cæsium is soluble in alcohol. In this respect it differs from carbonate of potassium. The double platinum salt is most insoluble in water. And this is the mode in which he first separates the two substances. The second new alkaline metal is rubidium, so called from the splendid red lines which it gives. It gives two red lines, splendid beyond anything we can see in the visible continuous spectrum of the luminous gas flame. They are of an extremely low degree of refrangibility. From these two magnificent lines, he gives it the name of rubidium. This gives all the reactions of potash, and forms the platinum salt; therefore it is extremely difficult to separate it from potassium and cæsium. From what I heard the other day, we may hope soon to have a full account of Bunsen's researches on those two metals. I believe he has very nearly finished his paper upon the subject.

It is obvious that only the spectra of such can be examined by means of the colourless gas flame as are volatile at the temperature of the flame. If the bead of the calcium salt remains long within the flame, it loses its red tinge, which calcium gives it, and we see no longer the characteristic spectrum of the calcium. This is not because the calcium salt is volatilised, but because it has become basic, and the basic salt is not volatile at the temperature of the flame. You will see also that the

magnesium salts are not included in the diagram of the alkalies and alkaline earths, because the magnesium salts are either non-volatile at the temperature of the flame, or are very easily decomposed. There are, indeed, a few salts of the heavy metals, such as the salts of copper, which tinge the flame, and which, therefore, give the spectrum peculiar to these metals; but by far the greater number of the metallic salts are non-volatile at the temperature of the flame, and require peculiar means of producing the incandescent vapour of them, in order to arrive at the result. By far the best and most generally useful manner of obtaining the characteristic spectra of the metals, is by employing the electric spark, and to observe the spectrum thus produced. Every metal can thus be readily converted into vapour, and bright lines distinctly seen. The easiest mode of obtaining a succession of sparks in less time than the impression on the retina remains, is by employing a spark from a powerful induction coil, such as we have here; by placing the Leyden jar with the outer coating in connection with one of the wires of the induction coil, and the inner coating in connection with the other wire, we obtain a much brighter spark than we otherwise should obtain. Masson has shown that the luminosity of the electric spark is in proportion to the heat, and the heat is dependent on the amount of electricity which passes from time to time; so that the larger the jar, and consequently the greater the amount of electricity which is discharged, the greater will be the amount of heat, and the greater will be the amount of light produced. In this way we can easily obtain a bright spark. [Experimenting.] This we can use, as I shall explain, for the purpose of seeing the spectra produced by the various metals. Wollaston, who first observed the dark lines in the solar spectra, was also the first to observe the bright line in the electric spark. Fraunhofer, in the year 1814, also observed many of these lines. Mr. Faraday appears to have been the first to declare that the electric spark consisted only of ponderable matter, heated in the same manner, and according to the same laws, as the voltaic current heats and volatilizes a metallic wire. Wheatstone, in the year 1835, at one of the meetings of the British Association, was the first, I believe, who pointed out that the spectra produced by the sparks from the poles of different metals were dissimilar; he concluded that the electric spark results from the volatilization or ignition, not of combustion of ponderable matter of the poles. The tables which accompany Wheatstone's paper are very incomplete; and although he first pointed out the practicability of employing such a method for the detection of the metals, his observation seems to have attracted but little attention. "These differences," says Wheatstone, "between the spectra observed when a spark passes, are so obvious, that any one metal may be instantly distinguished from others by the appearance of its spark,"—I suppose he means the spectrum of its spark,—"and we have here a means of discriminating more readily than by chemical examination, and which may be therefore employed for useful purposes;"—he means, of course, the electric spark from the machine. Masson was the next, in 1851, to observe the light-giving power of the electric spark, and to observe the spectra thus produced by the spark passing from poles of different metals; and in his paper "On the Luminosity of the Electric Spark," he devotes a certain portion of space to the consideration of the spectra produced by the passage of the spark from the various metals.

It is to the Swedish philosopher Angstrom, who, in the year 1855, investigated the subject so thoroughly, that we are indebted for the greatest part of our knowledge. Angstrom was the first, previous to Bunsen and Kirchhoff, to draw attention to this important fact, that the spectrum we observe from the spark passing the platinum wires is really due to the super-position of two spectra, and that the one spectrum is produced by the ignition of the simple particles of platinum, which are mechanically carried over from pole to pole, and heated to an enormously high temperature, and volatilized—that is, that one set of bright lines is owing to the ignition of the platinum, and the other set is owing to the ignition of particles of air through which the spark passes; and that, in fact, when we pass the spark through the air, we have two spectra, one consisting of the metallic spectrum, properly so-called, and the spectrum produced by the gas through which the metal passes. Now, these differences of brightness and distinctness of the lines produced by the air, is quite as great as the brightness and distinctness which the spectra of the metal itself possesses. In fact, we cannot distinguish between the two until we use some other mode of discrimination than I have yet spoken of. The effect of the different gases upon the light may be very well, and very easily and distinctly seen by passing the spark, at the same time, through the air from the platinum poles, and through hydrogen gas from two other platinum poles; we shall see that the colour of the hydrogen spark is totally different from the colour of the spark as it passes through the air. And if any gentleman afterwards will look through this, he will see a most beautiful phenomenon indeed. In the upper half of the field he will see the bright metal lines and the bright air lines; whether these are due to oxygen, nitrogen, or carbonic acid remains yet to be decided. Here is the bright spectrum of the platinum lines and the line of the air, and below is a most extraordinary spectrum, which is the hydrogen spectrum. We will notice the two lines of the platinum which pass through both, for those are extremely faint. First, there is one very splendid red line, which vies in intensity and in beauty with the red lithium line α, which, I dare say, most of you know. And this red line is produced by the hydrogen. Besides this, there is a bright band of green, which can be split up into a vast number of very thin and beautiful green rays. And, further on, there is one bright band of violet, which can also be split up into a great number of separate bands. Between these three bands there is nothing at all. The hydrogen spectrum is a most beautiful and a most peculiar one. The difference of the colour of the sparks is evident to all. The difference of the spectra I can only make visible to those who look through the apparatus.

In this way, then, by using different atmospheres for the same metal, we can tell which lines are due to the air, and which lines are due to the metal itself. We must, of course, in this way make use of the little prism. The light which will come from the hydrogen spark will be refracted through the prism to the upper half of this tube, and the light which comes from the air and the platinum will pass directly through the open slit below into the telescope. Without this arrangement of the little prism on the end of the slit, this experiment would be perfectly impossible. We could not detect which were the platinum lines and which were the lines of the air. I will now pass a spark through, and you will see the red spark of hydrogen, and the blue spark which is shown by the air. [Experimenting.] There is, however, another way by means of which we may know which are the lines of the metal proper, and which are the lines of the gas; and this of course we can tell by using two sets of poles of different metals. The air sparks pass through both these series of poles, and if we take away this small vessel which contains the hydrogen, and replace it by a similar arrangement to this, which contains, however, instead of platinum poles, poles of iron or copper, we shall then see that certain lines go all through from the top to the bottom; those are the lines of the air, and the lines which are only seen in the upper half of the field are the platinum lines proper; and those lines only seen in the lower half of the field are the copper lines proper, and in this way it is extremely easy to detect the presence of any of those metals. Just as in the case of the

alkalies and the alkaline earths, it is not necessary for the purpose of chemical analysis to have a complete representation of the whole lines, we only need to seek out two or three of the most characteristic and most distinct. Here, in the case of these lines of the metals, we have not to do with one or two lines, as we have to do in the case of sodium,—we have to do with hundreds and thousands, and we only need to look for the most distinct; we only need to distinguish certain lines as always occurring when copper is present, and certain others as always occurring when we have platinum present, and to get these distinctly, and to look for these lines when we want to know whether copper is present. That is the way in which it is done. If we have poles of platinum or poles of iron, we get the same result. If we have, for instance, two sets of platinum poles, we get, of course, the platinum spectrum and the air spectrum. If, then, we want to get the iron spectrum, we only need to moisten the surface of the platinum poles with a little solution of iron—I believe any solution of iron will do,—and we then get at once the bright iron lines. So with any of the metals. In the same way we can obtain spectra of the other metals; and in this way Kirchhoff distinguished, with the greatest ease, between yttrium, erbium, and terbium, lanthanum, didymium, and cerium. Each of these metals possesses distinct and characteristic lines, which are easily recognised and distinguished.

To what extent this method will prove applicable for the purpose of detecting the different salts of the different metals, remains still to be seen. You must remember that I bring these matters before you as mere beginnings of what is, I hope, yet to be done. Of course, very little has yet been done; but still I thought it might be interesting to the Fellows of the Society if I brought before them the method by which these ends may be accomplished. Of the details of the method, of course it is quite impossible for me or any one else to say anything. It would seem, however, that this method, I have just stated, like all other methods that are worth anything, has its difficulties. We often find, on placing two solutions of two metals on the poles, or when we take poles of certain compound metals, that we see only the spectrum characteristic of one. For instance, if we take German silver we sometimes get only the spectrum of one of the constituents of the alloy. This, however, is a difficulty of detail which can easily be overcome. It is not, however, quite so simple as electrolytic decomposition. As in the case of decomposition by the current in the wet way, we find that one metal is deposited before another. This subject is, however, being worked out by our German friends, and we may hope to hear, before long, something more about it.

We will now pass on from this consideration of the power of incandescent gases to give off light of a certain definite degree of refrangibility, or to furnish spectra consisting of certain fixed lines, to the remarkable consequence which Kirchhoff has deduced—that these luminous gases must also absorb light of the same degree of refrangibility as that which they emit. This proposition is the application to the vibrations which we call light of the celebrated statement that a body absorbs all those series of oscillations which it can propagate. Thus, if we sound a certain note in the neighbourhood of a piano, we know that only the corresponding note in the piano vibrates. This proposition Kirchhoff has applied to light; and he not only showed theoretically that this was true, but he confirmed his conclusions by experiment, and he showed that heated sodium vapour which has the power of giving off light only at the one refrangibility D, has also the power of absorbing that ray alone; and that the vapours of other metals, such as lithium, potassium, calcium, strontium, and so on, which have the power of giving off a particular kind of rays, has also the power of absorbing those same rays. If we place sodium vapour before the slit of our apparatus, whilst the sodium flame is burning, we shall have the sodium light entirely cut off. If while the potassium flame is burning here we put potassium vapour before it, we get these two bright rays cut off. This can be very well seen by a little experiment which was first proposed by Mr. Crookes. He takes a hydrogen flame coloured by sodium, and holds before it a smaller flame coloured still more intensely with sodium. If you look at the hydrogen jet which contains the larger amount of ignited sodium vapour, or sodium vapour of a higher temperature, and, therefore, giving off more intensely the line D—if, I say, you look at that on the background of a light less intense, you see that the sodium flame is surrounded by a dark mantle which is caused by the absorption of the light which passes from the hydrogen flame through the light behind. Another way is to take a tube and put some metallic sodium in it, and then pass in an atmosphere of hydrogen, and after rendering it vacuous to seal it up; and then by gently warming it over a large flame, a tolerably large quantity of the sodium can be brought into a vaporous state at a temperature lower than that at which it attacks the gas. When this sodium tube is held before a piece of white paper and looked at by the yellow day-light we see that the tube appears perfectly black wherever there is any sodium vapour at all. That is to say, the sodium-light cannot pass through; it is absorbed by the sodium vapour, whereas, by the common gas-light it is perfectly transparent.

Kirchhoff found in the solar spectrum lines which coincided exactly when allowed to fall simultaneously into his telescope. That is to say, when the solar light fell through the bottom half, or the uncovered part of the slit, and when the light from a metallic spectrum—the spectrum of iron, for instance,—was allowed to fall into the upper part of the slit, he found that certain lines in the sun corresponded with every line which the iron gave—that there was no iron line which had not its corresponding and coincident line in the spectrum of the sun. The bright iron line and the bright solar line corresponded perfectly. This was found to be the case not only with iron, but with chromium, and nickel, and magnesium. I have here a representation of a drawing by Kirchhoff of a very small portion of the solar spectrum—and it is allowed to be a very beautiful one indeed. It is a chromo-lithograph, but made with tinted inks instead of coloured inks to show the different darkness and the different tints and shadings of the lines on the solar spectrum. This shows the different lines of chromium and magnesium from "E" to "*b*." This is "E" [pointing] in the solar spectrum; this is "*b*" [pointing] so that the whole of these lines occur in the solar spectrum as represented here. Here you see a great number of lines; of which some are iron, some chromium, and some magnesium, and these show the coincidence of the iron lines. This line is a very dark one, and is one of the most easily visible lines in the solar group. It is represented in the map, and marked as little "*b*." This is found to be magnesium, and there is also another magnesium line as well. This then is the representation of a very small portion of the solar spectrum as yet given by Kirchhoff. This is only a very small piece of the map which he is about to publish.

In justice to Angstrom we must acknowledge that he came very close upon the explanation given by Kirchhoff. "The analogy," says Angstrom, "between the two spectra, the metal and the solar, may be more or less complete, when we consider the details. When taken altogether, they produce the impression of one being the reverse of the other. I am, therefore, convinced that the cause of the lines of the solar spectrum involves that of the bright electric lines." He supposed that it was, and Kirchhoff thought it was. I think the difference between these two will be understood by all. Kirchhoff proved it, and Angstrom suggested that it might be so.

Amongst one or two of the large number of interesting

fields which this has opened out may be mentioned the fact of the experiments and observations which have been made by Sir David Brewster and Dr. Gladstone regarding the appearance of certain other lines in the solar spectrum, lines which are seen under peculiar circumstances, either when the sun is low or when it is high. I am sorry Dr. Gladstone is not in the room. I believe at this moment he is at the Royal Society, giving an account of this same thing. Sir David Brewster found that certain dark lines or bands appeared in the solar spectrum when the sun was low; and these are represented in No. 2 in this diagram—the first red line representing the ordinary solar line; and the lines No. 2 are marked in the second spectrum red, in order to distinguish them from the other dark lines, so as to show that there has been a difference observed. Now, then, Angstrom drew maps of the bright lines which he noticed when the electric spark passed through the air. Now, it is curious that those two sets of experiments, made at different times quite independently of one another, seem to agree in every form. In this way we see very clearly—and I do not know that Dr. Gladstone was aware of this—that Angstrom's bright atmospheric lines correspond very nearly—as nearly as you can expect under such circumstances—with the dark bands observed in the actual observations made by Brewster and Gladstone. Here you see, for instance, between small "*b*" and "G" there is the same number of bands in both series, and you see the general character of these is the same, so that it appears then that in the atmosphere, even at this ordinary temperature, thick bands or thick columns of gas absorb the same kind of rays which they give off. That seems to be not only true, then, for high temperatures, but it would appear that it is also true of low temperatures as well. That is to say, that at low temperatures certain substances have the power of absorbing the same rays which, at the higher temperatures, they have the power of giving off.

(To be continued.)

NOTICES OF PATENTS.

An Improved Apparatus for Carburating Gas for Gas-lighting. E. C. Shepard.

The specification refers to a particular method of effecting the impregnation of lighting gas with naphtha vapour by the use of an apparatus therein described. A single carburator serves either one or several burners, being placed near or remote as may be most convenient, but preference is given to an arrangement whereby each jet of gas is provided with a naphthalizing apparatus placed near the burner. By means of a float the saturation of the gas by the fluid, hydrocarbon is rendered tolerably constant, notwithstanding the varying depth of this latter in the reservoir, and diaphragms of wire-gauze are employed to ensure uniformity of impregnation.

A suggestion for increasing the illuminating power of coal-gas by the admixture of naphtha vapour was practically and successfully carried out many years since by the late Mr. Charles B. Mansfield, whose enthusiasm in this direction of chemical study led unfortunately to his falling a victim whilst being engaged in the distillation of a large quantity of coal-tar naphtha. Since the period of Mr. Mansfield's original experiments, efforts have from time to time been made with the view of converting the suggestion into a scheme of practical utility. More recently the naphthalizing apparatus has been adapted to the gas-lamps in Moorgate Street, London, and we are assured, as the result of this trial, that, whilst the photogenic value of the light has suffered no diminution, a saving in cost has been effected. The great demand which has lately arisen for the lighter products of coal-tar naphtha to be used in the preparation of the purple dyes will probably restrict the application to these purposes of the less volatile hydrocarbons, (toluol, &c.,) which may nevertheless be well-fitted for employment as auxiliaries in gas lighting.

Treating Lava and other Volcanic Substances in order to fit them for Employment in Certain Arts and Manufactures. R. A. Brooman. A Communication. (Not proceeded with.)

The inventor contemplates the utilization of lava, puzzolano, and other volcanic substances by melting them alone or with the addition of any suitable flux, such as red-lead, borax, lime, potash, or soda; and, accordingly as the heated materials are fluid or pasty, they may be cast or moulded into objects of various shapes; for instance, slabs for tables and mantelpieces, architectural ornaments, tiles, and blocks suitable for building. The specification describes the several mechanical operations to which it is advisable to submit the volcanic matters prior to their treatment in the furnace. Also, it asserts a claim for the employment of the same substances, in the state of powder, for the purposes of a glaze in the manufacture of pottery.

In judging as to the expediency of employing the substances of volcanic origin enumerated in the specification, we are reminded of the oft-repeated attempts to utilize the abundant sources of ready-fused material offered by the blast furnace, and in so many other similar metallurgical operations. Blocks of slag have been used for rough building purposes, and not long since a Company was established (with what success we know not) for the purpose of undertaking the manufacture of useful articles from the unsightly heaps of slag which occupy and disfigure so many acres of land in the neighbourhood of our copper and iron-works.

An Improved Lubricating Grease or Paste for Railway Wheels and all Kinds of Machinery. F. W. Serrott, Hanover Cottage, Walworth.

This invention consists in the use of micaceous ore combined, by preference, with oleaginous or fatty matters, or both together, or other suitable substances, in the manufacture of grease or paste for lubricating the axles of locomotives and carriages, the bearings of engines, and working parts of machinery. The micaceous ore which is employed for this purpose is that well known as a species or variety of hæmatite iron ore found in various parts of this kingdom. It is soft, greasy, and friable in its nature, and forms a good base or principal component part of a lubricant when combined with oleaginous or fatty matters, or both. Being of considerable specific gravity, it has more body or substance than many other materials used for lubricating purposes, and does not so readily run or melt from the action of the sun or continuous working of the machinery to which it is applied, and, therefore, lasts longer, and when properly prepared and mixed with oleaginous or fatty matters will not injure the spindles, shafts, axles, or bearings of any engine, carriage, or machine. Most chemists are aware of the apparent greasy properties of some hæmatites. These are here utilised in an ingenious manner; but Mr. Serrott is mistaken if he thinks his idea possesses much novelty. It has been employed frequently for lubricating the bearings of axles and machinery which have to be subjected to great heat.

Brewing Malt Liquors. H. Medlock, Great Marlborough Street, London.

In this invention the inventor soaks the hops in water, the temperature of which must not be high enough to coagulate the albuminous matter; 160° F. will generally

be found to be the maximum temperature which can be safely used. He prefers a heat from about 120° to 150°. During this process the volatile aromatic substance is produced and dissolves in the water. The albuminous matter is also dissolved, the heat not being sufficient to coagulate it. He then strains the water from the hops, removing by this means the volatile aromatic substance, and albuminous matter. After the hops have been so treated, he boils them with the wort in the usual way, by which he effects the combination of the resinous matter with the gluten of the malt, the absence of the albuminous matter greatly facilitating the extraction of the former, and of the bitter flavour of the hops. The combination of the resinous matter of the hops and the gluten of the malt subsides on cooling the wort, and may be separated from it in the usual way. When the wort has sufficiently cooled, and before or shortly after the fermentation begins, he adds to it the cooled solution of the volatile aromatic substance, which, with the albuminous matter, has been extracted. Mr. Medlock's patent was not proceeded with, —not, we should imagine, from any want of success in carrying it out, for the plan seems to be highly original and ingenious.

Improvements in the Manufacture of Sulphurous Acid, Sulphites, and Bi-Sulphites, and Sulphuric Acid, and in the Application of one of the Products of such Manufacture to the Bleaching of Textile, Animal, and Vegetable Substances. C. A. Drevit, Rouen. (Not proceeded with.)

To produce sulphurous acid the inventor introduces through an opening into a cast iron retort a quantity of sulphur, which he melts by heat from a furnace; when it is inflamed, the retort is hermetically closed, and a current of air is caused to enter through a pipe through a perforated plate by means of a bellows. The sulphurous acid thus produced passes through a receptacle divided into compartments (in which the flower of sulphur deposits), and is cooled in a leaden worm, whence it is passed into the receptacle with compartments containing either water or a solution of a base or of a carbonate; the free nitrogen and carbonic acid gas (when he employs a carbonate) escape into the atmosphere through an opening.

Paper Pulp. W. Clark, Chancery Lane, London. A Communication. (Not proceeded with.)

This invention relates to the manufacture of a new pulp for cardboard with tanners' waste, such as spent tan and varec (sea-weed), which are submitted to various preparatory processes.

Preserving Animal Substances. W. Clark, Chancery Lane, London. A Communication.

This invention relates to the preservation of animal substances by the employment of talc, laminated or scaly, or of other kinds, and generally in the employment of any other inorganic matters of insoluble nature, or of argillaceous earths, serving as ceramic bodies, or sulphate of baryta, carbonate of lime, and others. All these substances are reduced to powder to be applied on the animal substances, which are preserved in a fresh state, and ultimately brought to a proper state of desiccation. We are at a loss to conceive what possible effect smearing an animal substance over with an earthy powder could have upon its preservation from decay. If the animal matter can be kept perfectly dry it will not alter. If, however, it gets damp, the superficial coating of a perfectly indifferent body cannot save it.

Grants of Provisional Protection for Six Months.

1671. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in apparatus for manufacturing and bottling aërated liquids."—A communication from Messrs. Auguste Mondollot and Jean Alphonse Mondollot, Paris.

1817. Robert Mushet, Coleford, Gloucestershire, "Improvements in the manufacture of cast steel."

1869. Edward Haeffely, Kearsley, Lancashire, "Improvements in extracting copper from its ores."

1893. Wentworth Lascelles Scott, Bayswater, Middlesex, "Improvements in preparing red, purple, and certain other dyes."—Petitions recorded July 29, 1861.

1955. Alcidalis Auguste Romain Damoisseau, Paris, "Improvements in apparatus for drawing blood or other fluids from the human or animal body."

Notices to Proceed.

894. Charles Noyes Kernot, Gloucester House, West Cowes, Isle of Wight, and Martin Diedrich Rucker, Fenchurch Street, London, "Improvements in the method of obtaining ammoniacal salts and other valuable products from liquors or substances containing ammonia, and for utilising the residuum."

925. Robert Charles Furley, Edinburgh, Mid Lothian, N.B., "Rendering pills tasteless by means of a coating of albumen."—Petitions recorded April 15, 1861.

948. Hugo Carstanjen, Cologne, "Improvements in the apparatus for, and method of, increasing the illuminating power of gas."

955. Richard Archibald Brooman, Fleet Street, London, "Improvements in producing photographic pictures."—A communication from Adolphe Fargier and Nicolas Charavet, Paris.—Petitions recorded April 18, 1861.

1076. William Edward Newton, Chancery Lane, London, "Improvements in desiccating and torrefying farinaceous and other substances."—A communication from Francis Huckins, Roxbury, Norfolk, Massachusetts, U.S.—Petition recorded April 29, 1861.

CORRESPONDENCE.

White Gunpowder.

To the Editor of the Chemical News.

Sir,—I find some difficulty in reconciling the account given by Dr. Pohl, and that given by Mr. Hudson relative to the manufacture of white gunpowder. Dr. Pohl speaks of the ease and safety with which it may be manufactured; also of the impossibility of causing it to explode by rubbing between wood and metal, or between stones. And yet Mr. Hudson's assistant almost lost his eyesight by simply crushing some of the larger pieces with a spatula in a porcelain dish. If white gunpowder is to be prepared moist, what is to prevent it caking when dry? and, when caked, is it all to be broken up by hand because it will not bear friction? And suppose the white gunpowder made, dried, and pulverised, what is to prevent it caking again? I apprehend the difficulties and dangers in the manufacture of this material will be found greater than those who are practically unacquainted with the manufacture of gunpowder, black or white, imagine.

I am, &c. J. M. C.

Antidote to the Phosphorus Disease.

To the Editor of the Chemical News.

Sir,—In reading the interesting account in the Chemical News of Aug. 17, of "The Origin and Progress of the Phosphorus and Match Manufactures," by Mr. Gore, my attention was drawn to that part wherein he states that the manufacture of matches "is not without some serious drawbacks;

it produces a most painful disease, which attacks the jaw-bones of the work-people, and causes them to decay." This, of course, is caused by the inhalation of the poisonous garlic odour. Now, it occurs to me, that as arsenic (which also, when heated, emits a strong odour of garlic) has been found useful in malignant or cancerous ulcerations, especially of the skin of the face, in lupus, and Hospital gangrene, and as phosphorus is seen to produce a disease similar to the above, might not the cautious use of arsenic as a prophylactic be tried in this formidable disease? Both give out a garlic odour. The one cures a disease, the other, carefully administered, has been found to cure diseases something akin to the one produced by phosphorus. I am not a believer in Homœopathy, but there is something here, to my mind, like *similia similibus curantur*.

I read of a case lately, where a lady, for long a martyr to asthma, was induced to smoke a small quantity of arsenic with stramonium, beginning with about half-a-grain. After persisting in its use for some time to her great relief, she experienced a complete immunity from the paroxysms of asthma, and much improvement of health. The only inconvenience she felt was, at first, some giddiness and tightness of the eyeballs, which gradually went off. The foregoing preamble brings me to this, viz.:—Might not those operatives who are exposed to the vapours arising from the match composition, and even those affected with disease already, smoke arsenical cigarettes, made of a safe and proper strength?—

I am, &c. HENRY DUNBAR, M.D.

Glasgow.

Preparation of Iodine.

To the Editor of the CHEMICAL NEWS.

SIR,—In the preparation of iodine, after the mother-liquor has been exhausted by the sulphuric acid and manganese, on testing with starch there still remains a considerable apparent quantity. Is there any means of separating it from the residue?—I am, &c.

A CONSTANT READER.

Chemical Notices from Foreign Sources.

I. GENERAL CHEMISTRY.

Reciprocal Relations of Atomic Weights.—Stas has just published (*Recherches sur les Rapports Réciproques des Poids Atomiques. Bruxelles*, 1860) the results of ten years' experiments, made with the view of testing the truth of Prout's theory—that the atomic weights of all simple bodies are divisible by that of hydrogen. These experiments, we are informed, have been conducted with a care and perseverance never surpassed in the history of experimental investigation, and the conclusion which Stas has arrived at is, that there is no common divisor for the equivalent weights of the simple bodies, and he expresses his conviction that Prout's law, and the later modification of Dumas, are untenable. The differences in the numbers Stas has obtained are not very great, but some of his conclusions are important. We shall return to the work soon for further details, and for the present only quote two or three of the corrected numbers:—

Potassium,	39·13	Silver,	107·943	Nitrogen,	14·041
Sodium,	23·05	Chlorine,	35·46	Sulphur,	16·0371

Rubasse.—A beautiful red-coloured stone has lately been popular in Paris, and brought high prices to the jewellers. Schaffgotsch (*Polytech. Notizblatt.*, Bd. xviii. s. 10) examined a specimen, and found that, when placed in ammonia, it soon lost its beautiful colour, and became a simple piece of rock crystal. It was, indeed, a specimen of quartz, the minute fissures in which had apparently been filled with a solution of carmine.

Preparation of Hydrate of Baryta.—Müller recommends (*Journ. für Prakt. Chem.*, Bd. lxxxii. s. 52) the preparation of hydrate of baryta from sulphide of barium and oxide of zinc. The last is slightly soluble in baryta water, but it can be easily removed by a little sulphide of barium reserved for the purpose. Any traces of sulphur remaining may be got rid of by adding a little sulphate of copper. If any thionic acid is formed during the operation, it may be got rid of by calcining the baryta obtained with a little nitrate of baryta.

II. ORGANIC CHEMISTRY.

Oil of Cajeput.—Schmidl publishes (*Trans. Royal Soc. Edin.*, vol. xxii., p. 360) some researches on cajeput oil. His analysis agrees with that of Blanchet and Sell—$C_{20}H_{16} + 2HO$,—but instead of the name *Dadyle* given to it by these chemists, Schmidt proposes to call the oil the *Bihydrate of Cajeputene*. It boils at 175° C., becomes acid in the air, especially in the presence of alkalies; hydrochloric acid separates a resinous body. When heated to boiling and some sulphuric acid is added gradually, the oil becomes coloured, and between 170° and 175° a liquid distils having the composition $C_{20}H_{16} + HO$, which the author considers the *monohydrate of cajeputene*. The vapour density of this body is 5·02, and corresponds to 4 volumes, which, as it contains an odd atom of oxygen, is an exceptional case. Repeatedly distilled with anhydrous phosphoric acid this monohydrate forms a series of hydrocarbons of different degrees of volatility. The first *cajeputene* $C_{20}H_{16}$ boils between 160° and 165°, and is a colourless liquid, smelling like the hyacinth: it is insoluble in alcohol, but soluble in ether and oil of turpentine. Its sp. gr. at 15° is ·850; vapour-density 4·717. Between 176° and 178°, *Isocajeputene* passes; like the former it is insoluble in alcohol, but soluble in all proportions in ether and oil of turpentine.

Paracajeputene comes over about 316°: it is a viscid fluid of a lemon-yellow colour, slightly fluorescent: unlike the two former, it is insoluble in turpentine; in the air it soon changes to a red resin.

Iodine acts on these hydrocarbons when heated, and hydrogen is evolved. Bromine thickens cajeputene and isocajeputene, which are converted into a friable resin by a mixture of sulphuric and nitric acids. Hydrochloric acid colours all three violet, but does not form a definite compound with them. When, however, oil of cajeput is shaken with hydrochloric acid an unstable compound $C_{20}H_{16} + 2HCl$ is formed, which heated to 160° parts with one equivalent of the acid.

Bichloride of Cajeputene is formed when a current of chlorine is passed through a solution of cajeputene in nitric acid. It is a heavy crystallizable oil with an agreeable smell; it decomposes on distillation, and detonates with nitrate of silver.

The author has also obtained a bromide, $C_{20}H_{16} + 4Br$, and a hydriodate, $C_{20}H_{16} + HI$.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business Communications* to the PUBLISHER at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Lightning.—Connect the lightning-rod with the gas or water-pipes of your house.

F. S. L.—We have had some experience in the matter you speak of, and have no hesitation in saying that you will not succeed unless you use a stronger acid. There ought to be at least 1 part of sulphuric acid to 4 of water, by measure.

Erratum.—Article "On Rosolic Acid and the Rosolates." No. 89, p. 90. The Author's name is erroneously printed "Jouvin;" it should be "Jourdin."

THE CHEMICAL NEWS.

VOL. IV. No. 92.—September 7, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a New Sulphide of Chromium, by T. L. PHIPSON, *Phil. Nat. Doct., Brussels University, Member of the Chemical Society of Paris, &c.*

IN endeavouring to form sulphochromic acid, CrS_3, corresponding to chromic acid, CrO_3, I discovered the existence of a new sulphide of chromium, Cr_2S_7, which was obtained in the following manner:—

Bichromate of potash is neutralised, and then supersaturated with ammonia; it is then placed in a three-bulb tube and a rapid current of sulphuretted hydrogen is passed through it for a long time. The liquid, sooner or later, becomes dark and cloudy, and then a brown precipitate is formed. This precipitate is Cr_2S_7. When it is collected upon a filter, the liquid which passes through is dichroïc; it is reddish-brown, with green reflections, and probably contains an alkaline sulphochromate. However, upon adding diluted hydrochloric acid to this liquid, care being taken not to saturate completely, I could not obtain CrS_3 (sulphochromic acid), but a new quantity of persulphide, Cr_2S_7. Here are the analyses:—

	I. Body deposited during the passage of HS.	II. Body precipitated by the acid.	Mean.	Calculation for Cr_2S_7.
Chromium	32·64	32·21	32·42	32·42
Sulphur	67·36	67·79	67·58	67·58
	100·00	100·00	100·00	100·00

This new body is not a mixture of sulphochromic acid and sulphur, $2CrS_3 + S$, but a distinct and definite compound, Cr_2S_7; for sulphide of carbon cannot extract any sulphur from it. Besides, the following reactions tend, as well as its composition, to point out its true nature:—

Acids decompose it, with evolution of sulphuretted hydrogen and formation of a chromic salt, whilst sulphur is liberated,—

$$Cr_2S_7 + 3HCl = Cr_2Cl_3 + 3HS + 4S.$$

With caustic soda, chromic oxide, bisulphide of sodium (which gives to the liquid a yellow colour), and sulphur, are formed,—

$$Cr_2S_7 + 3NaO = Cr_2O_3 + 3NaS_2 + S.$$

Persulphide of chromium is easily decomposed, and requires, therefore, to be isolated and dried promptly. In contact with water or damp air it, sooner or later, forms chromic oxide, Cr_2O_3, and sulphur. When heated it gives off sulphurous acid, and leaves a residue of peroxide of chromium, CrO_2, of a brown colour, which, when heated more, evolves oxygen, and becomes Cr_2O_3 (green), with evolution of light. When washed and dried it forms an amorphous powder, of a greenish-brown colour. Its composition renders very probable that of perchromic acid, Cr_2O_7, discovered by M. Barreswil.

In the dichroïc liquid mentioned above, I fancy sulphochromic acid, CrS_3, must be present, though I have not yet isolated this compound; for as soon as a dilute acid is added to the liquid, the sulphochromic acid set at liberty immediately combines with more sulphur to form Cr_2S_7, which is precipitated.

When, instead of passing HS into a chromic solution supersaturated with ammonia, this gas is passed into bichromate of potash supersaturated with soda, a very small quantity of brown precipitate is formed, and soon disappears, giving place to a magnificent green precipitate, which upon analysis gave:—

	Found.	Calculated for $Cr_2O_3 + 8HO$.
Chromic oxide	51·61	51·81
Water	48·39	48·19
	100·00	100·00

It is, therefore, the common green hydrate of chromic oxide.

The persulphide of chromium, Cr_2S_7, is not a sulph-acid; it does not dissolve in alkaline sulphides, and by this circumstance coincides with certain theoretical data which I shall make known at some future period.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. MULDER, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page* 101.)

When equal quantities of sulphate of potassa and chloride of magnesium are dissolved in water and left to crystallise, there is first obtained SO_3,KO, afterwards a double salt $KO + SO_3,MgO$, next MgCl, and finally SO_3,MgO. (*Berthollet, Stat. Chimie*, i. p. 100.) A similarly varying separation of potassa and magnesia salts may be observed on evaporation of the brine of sea-water. A great many instances are known relating to the solubility of salts, which otherwise are insoluble, in case other salts are present at the same time in the same liquid. Two solutions, the one containing 1 per cent of carbonate of soda, the other containing 1 per cent. of sulphate of magnesia, do not form a precipitate when added to each other, but a precipitate is immediately formed in case the liquids contain in solution 1½ or 2 per cent. of the said salts.

The magnesia alba which is formed in this case remains soluble in 200 parts of water, while it requires

otherwise 2500 parts of water to become dissolved (*Fyfe*).

If two solutions, each of which contain upon 100 parts of water the first 7⅓ parts of chloride of calcium, and the other an equal quantity of sulphate of magnesia, are added together, no precipitate will be formed in these 200 parts of water; but the 5·75 parts of gypsum which are here generated, require usually for every 1 part of gypsum 438 parts of water for solution (*Anthon*), (*Brandes in Schweigger's Journ., N. R.*, Bd. 13, s. 158).

If a solution of gypsum is added to a solution of a salt of strontia, sulphate of strontia is produced. That precipitate gets slowly dissolved on addition of common salt. This does not take place with sulphate of baryta. Common salt, therefore, dissolves sulphate of strontia.

Gypsum, which requires, according to Anthon, 438 parts of water for solution, is completely dissolved in 122 parts of a saturated solution of common salt in water. Rock salt often contains gypsum. Gypsum is also soluble in a solution of acetate of soda, and there is no reason to suppose, that in this case a double salt is formed. If sufficiently strong solutions of sulphate of soda and of acetate of lime in water are added together, and afterwards divided into two equal parts, then it will be seen that on addition of common salt to one of the two parts, that that portion to which common salt was added will become clear, the other remains turbid from the first formed precipitate of sulphate of lime. Lime water, which has become turbid by the action of carbonic acid, becomes, according to Guyton, clear on addition of a solution of chloride of potassium or of sulphate of potassa (*Berthollet, Stat. Chim.* i., p. 103).

The solutions of the salts of the peroxide of iron are precipitated by the carbonates of the alkalies, but such does not happen when tartaric acid is, at the same time, present in the solution. Sugar produces the same effect; and although it be supposed for the first case, that the tartrate of iron which gets formed cannot become decomposed by alkalies or their carbonates—which supposition, however, is not in concordance with general chemical rules, even then it is in every case still an anomaly to chemical affinities, that sugar should prevent the precipitation of salts of peroxide of iron. The salts of oxide of copper behave similarly under the same conditions. Oxalic acid behaves in a curious way with salts of peroxide of iron and the so-called yellow prussiate of potassa, ferrocyanide of potassium. In case oxalic acid is present, Prussian blue is also formed, but this, instead of being precipitated, remains in solution (blue ink). There can be no doubt here of real chemical action, since the new compound is equally well formed, but remains in solution.

These, then, are a few instances of what we call physical force exercising influence upon the chemical formation of substances; for there can be no doubt whatever, that these substances do not exist as such in the solutions, when, in accordance with their nature, they ought to have been precipitated long before. The idea we ought to have about these phenomena may be explained shortly, according to Berthollet, in the following lines:—

When two salts which are in solution decompose each other mutually, then there are not formed two, but four salts, which do exist in greater or less quantity in the liquid, just as long a time as is required to restore the equilibrium between chemical and physical action. If, for instance, a solution of chloride of calcium and a solution of sulphate of magnesia are mixed together, then there will soon be two other salts in the solution—viz., sulphate of lime and chloride of magnesium. Whether a precipitate is formed in this case, does not only depend upon the insolubility, or upon the more difficult solubility, of one of the salts in water—in this case, for instance, the gypsum—for we have here not simply water; it entirely depends upon the insolubility of that salt in the saline mixture. In case the substance is insoluble therein, then it becomes entirely thrown down; if it is only slightly soluble therein, then much of it becomes thrown down; if, on the contrary, it is very soluble therein, then none, or only a little, becomes thrown down. A very marked example thereof is exhibited by sulphate of potassa and chloride of calcium; the precipitate, (of sulphate of lime,) which they produce is by far smaller than is in relation to the solubility of gypsum in water. That which remains in solution of the four salts—viz., sulphate of potassa, chloride of calcium, sulphate of lime, and chloride of potassium, is in the state of physico-chemical equilibrium.

Wherever, therefore, we have to do with salts, or generally with substances of different nature which are dissolved together in a liquid, there we have to do more or less with influences similar to those which we have mentioned in the foregoing instances. The experiment of determining silver in the moist way is only excluded from such influences for him, who thinks chloride of silver to be perfectly insoluble, and who despises the great facts brought to light by the master hand of Berthollet. He, however, who is deeply penetrated by the truth that probably the presence of some substance, but certainly that of many substances, may exercise its influence on the chemical separation of another substance, will surely investigate with great care if such an influence does exist, and what may be its value in every peculiar case.

As soon as we have to do with pure silver in estimating that metal by the moist way, the presence of these substances which are unavoidably necessary, and which do not seem to exercise any chemical action at all, can, however, be of some notice; but in case we have to do with impure silver, then the influence of these other foreign substances can become so great, as to interfere largely with the results.

The first part of this memoir treats on the investigation of the influence of these foreign substances.

2. **Chloride of Silver.** — The formation of the chloride of silver forms the chief and principal point in the assay of silver by the moist way; and although it may not be our intention to treat here of the generally well-known properties of this substance, still there are some of its properties which must be mentioned if we wish to become thoroughly acquainted with the whole method of assaying silver by the moist way, and of that which has any influence thereupon.

Hydrochloric acid and soluble chlorides precipitate from a soluble salt of silver, white chloride of silver in the form of a so-called curdy precipitate. It is a loosely coherent, flocculent precipitate, which by shaking, or by being heated, collects together the smallest particles of the precipitate and renders the liquid quite clear.

There are only a few substances which yield so spongy a precipitate as chloride of silver. It appears as flocks, the particles of which retain, even after strong agitation of the liquid in which they float about, their coherence, and they even resume that coherence if it has been disturbed momentarily by a strong stirring of the liquid. The smaller particles of the precipitate which float about in the liquid, are taken up in that spongy mass more or less in the same way as the flocks of coagulated albumen render clear a turbid liquid. Application of heat produces movement in the liquid, and what-

ever produces motion in the liquid brings the smaller particles in contact with the more flocculent ones, whereby, while the liquid is rendered clear, the smaller particles are taken up by the larger.

The liquid, after shaking, does not always become perfectly clear; the operator has the faculty, and it is even optional with him, to render the liquid more or less clear. A more coarsely flocculent precipitate is obtained, when after the first addition of the solution of common salt to the silver salt, some of the latter is still left unprecipitated, if then a fresh portion of the solution of common salt is added, and the liquid briskly shaken, the first formed more coarse precipitate takes up very readily the large number of smaller particles of chloride of silver obtained after the second addition of the solution of common salt, and the liquid is rendered always perfectly clear. I shall have occasion to return to this fact, which is of very great importance for the estimation of silver in the moist way.

Chloride of silver is soon discoloured by the light of the sun, being rendered violet and heavy, whilst some chlorine is set free. According to Pohl (*Jahresb. von Liebig und Kopp*, 1851, s. 369) chloride of silver, which is precipitated at a temperature of from 60° to 80° C., is not discoloured by light for many days, if it remains in the liquid kept at that temperature. According to the same, discoloured chloride of silver would become, under these circumstances, somewhat more white, although not quite so white as when it was first formed. These observations, however, I have not found confirmed.

Wittstein (*Repert. für die Pharm.* Bd. xxxvi. p. 170) assumes the existence of a subchloride, $Cl\,Ag_2$, in the chloride of silver which is discoloured by light: he affirms that it is not attacked by nitric acid, and that it is decomposed by ammonia into chloride of silver, which is dissolved therein, and into metallic silver, which remains undissolved.

Dumas (*Ch. App. aux Arts*, tome iii. p. 653) is perfectly right when he says, that the quantity of subchloride which gets formed is very small, and the quantity of chlorine which is set free, therefore, very small also. According to Rose (*Analyt. Ch.* ii. s. 200), it is impossible to find any difference in the weight of the white and discoloured chloride of silver, when even a very sensible balance is used. A quantity of 1 gramme of pure silver was dissolved in nitric acid, and precipitated by a solution of common salt added in precisely sufficient quantity to obtain the point of chemical neutrality,—there was, therefore, neither excess of silver, nor excess of salt,—the bottle containing the precipitate was exposed to light, and sufficiently shaken from time to time, in order to discolour as much as possible all the particles of the chloride of silver. I did not find in the liquid afterwards a larger quantity of free chlorine than could be saturated by 6·25 milligrammes of silver. One gramme of silver forms 1·33 grammes of chloride of silver. The 6·25 milligrammes of silver required to saturate the chlorine which was set free in this experiment, represent only 2·06 milligrammes of chlorine; in case subchloride of silver only had been formed, the half of 0·33 gramme, that is 0·165 gramme of chlorine, should have been set free. In this experiment only $\frac{1}{83}$ chlorine of the chloride of silver had been set free. It is accordingly perfectly possible to weigh the difference, and therefore what Rose mentions is not quite correct.

The violet-coloured matter which is formed when chloride of silver is exposed to light is a mixture; part of it is perfectly soluble in liquid ammonia, while another part of it gets decomposed by ammonia, of which part again is rendered insoluble, the latter being metallic powder.

Some chloride of silver, which had been precipitated from a solution of nitrate of silver by means of common salt, and which had been exposed for some time to the light of the day, was carefully freed from the supernatant liquid, and some liquid ammonia was poured over it. Nearly all of it got dissolved, a small portion of it only, after having been in contact with excess of strong liquid ammonia for some time, remained insoluble. This small portion exhibited the same colour as the powder of minutely-divided silver, as it is separated, for instance, by precipitation by formic acid; it did not possess any violet tinge, and therefore the violet tinge of discoloured chloride of silver cannot be attributed to this substance.

The metallic particles, which are insoluble in liquid ammonia, are of variable size, few of them are so large that they can be retained by a filter. They are soluble in nitric acid, and the solution is precipitated by a solution of common salt; these small particles are, therefore, metallic silver.

Besides these particles of metallic silver, violet coloured, flocculent chloride of silver, when dissolved in liquid ammonia, gives rise to the formation of a colourless liquid, which being supersaturated with nitric acid, yields again pure white chloride of silver, all the violet colour being gone. The explanation of these phenomena is the following:—Daylight in fact reduces a small portion of chloride of silver to subchloride; from $Cl\,Ag$ is made a small portion of $Cl\,Ag_2$, which latter has a violet colour. If to the $Cl\,Ag_2$ ammonia is added, or if ammonia is poured over it, it then yields a colourless solution, while metallic silver is separated, and from $Cl\,Ag_2$ there is made $Cl\,Ag$ and Ag. The former is readily dissolved in ammonia, and can be reprecipitated again as white $Cl\,Ag$ on addition of excess of nitric acid. The silver can be dissolved by nitric acid. Wittstein's observation, therefore, is quite correct. Even on being warmed with it, nitric acid does not change violet-coloured chloride of silver to white; chlorine water, however, produces this effect instantaneously. The reason why chloride of silver, which is so readily changed by the daylight into subchloride, is not totally changed into it, is entirely due to the chlorine which is set free. An excess of chlorine is an impediment to the formation of the violet material, a little chlorine prohibits its formation. This also is an interesting instance of the influence of mass on chemical affinity.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On Coca, or Folha Sagrada—Erythroxylon Coca.

T. Peckolt reports, in *Archiv. der Pharmacie*, ciii. pp. 39—42, on the following paper of Dr. Valdez:—

Coca is the leaf of a shrub, growing to the height of not over six feet, and cultivated almost exclusively in Peru and Bolivia, recently also in the Brazilian province of Alto Amazonas. At the time of discovery the plant was used only by the Incas and the royal family, and looked upon as the image of a deity. Nobody entered the enclosure or sanctuary where it was cultivated, without previously kneeling down as a sign of adoration. Sacrifices were believed not to be acceptable unless crowned with a twig of this shrub. Oracles would not

answer, and their prophecies were terrible, if coca was not chewed on interrogating them. The Indian found consolation with this divine plant in all misfortunes and when praying for happiness.

Gradually its use extended to the whole population, and it became an important commercial article. Shortly before the independence from Spain, Peru produced coca valued at 2,841,487 dollars, and the leaves circulated occasionally as money. The Indians, in using them, are thereby enabled to perform the hardest mining operations in the midst of deadly metallic exhalations, without resting, and without protection against the unfavourable influences of climate. They march hundreds of miles through deserts, and over steep mountains, subsisting solely on coca, and frequently carrying burdens over places impassable for beasts of burden. Some travellers ascribe this astonishing frugality and abstinence from food to the effect of habit, without remembering that the Indians are naturally very voracious, and lose their strength when abstaining from chewing the leaves.

Coca leaves have a faint and agreeably aromatic odour, particularly when chewed; their taste is somewhat bitter and astringent, and colours the saliva green. They are strengthening, giving tone to the stomach, and are employed against intermittents, though with less decided results than cinchona. They are mixed with lime prepared from certain plants, and used like betel in the Indies. With it and a handful of roasted corn (maize), an Indian travels a hundred miles afoot, keeping pace with a travelling horse. Travels in the Andes are undertaken with an Indian, and it happens on hot days, that the horse is fatigued before the Indian.[1]

It is a narrow leaf, little over an inch in length; there are two species, one 2, the other 1½ inches in diameter (length ?). The former is called *cacha*, and is superior and more esteemed than the commoner one, which is used only in cases of need and by the poorest people. The culture of this shrub is very troublesome, it being subject to the attacks of a little insect, which sometimes devastates a whole plantation in a single night. Three years after planting, the shrub commences to bear fruit. The harvest of coca, called *palla*, is very laborious, and usually left to women; they commence at dawn to collect the coca into little trunks, leaf by leaf, with the greatest care, so as not to break the stalks or otherwise injure them; a good workman fills ten such little trunks by night. The collected leaves are dried in the sun for two or three days with great care, so as not to become wet or moist, whereby they would be entirely ruined. This procedure is called *seca*, the box containing the fresh leaves *gerga*, and the collectors *palhadoras*. The leaves are afterwards packed in bags of 1 arroba (= 32 lb.), and sent to the cities, among which Cusco receives the largest cargoes; from here all the departments of Peru and Bolivia are supplied. But a few years ago, coca was cultivated scarcely outside of Valles de St. Anna; now there are plantations at Paz, Cochabamba, and Alto-Peru, but the quality is inferior.

Coca drank as tea has the same aroma and taste as the finest pearl tea, without any stimulating qualities; from its numerous good properties, it promises to become an important commercial article of Peru and Bolivia.

[1] It has been variously proposed to supply emigrant and other ships with coca leaves, to be used as food in case of shipwreck and other accidents. Their introduction into the army and navy has likewise been advocated, and it is likely that they will be employed in some of the European armies, in order to test their efficacy in keeping up the strength and vigour of the men in urgent cases when food cannot be had.

PHYSICAL SCIENCE.

On Nobert's Test Plate and the Striæ of Diatoms, by W. S. Sullivant *and* T. G. Wormley.

The limit of the resolvability of lines, or how small a space can exist between lines and still admit of their being separated under the microscope, appears to be an undecided point. Professor Queckett ("Treatise on the Microscope," third edition, p. 238, 1855) asserts that "no achromatic has yet been made capable of separating lines closer together than the $\frac{1}{75000}$th of an inch." In the same work, p. 245, it is stated that Mr. Ross found it impossible to ascertain the position of a line nearer than the $\frac{1}{80000}$th of an inch. We also find on p. 512 that Mr. De La Rue, in his extended examination of Nobert's test plates, was unable to resolve any lines closer than the $\frac{1}{81000}$th of an inch. In Professor Carpenter's work ("The Microscope," second edition, p. 189, 1859), this sentence occurs:—"The well-defined lines on Nobert's test plates have not yet been resolved when they have approximated more closely than the $\frac{1}{85000}$th of an inch."

From the foregoing, it appears that actual experiment fixes the limit of resolvability at about $\frac{1}{81000}$th of an inch. This does not, as is said, vary widely from the deductions of Fraunhofer and others, based on the physical properties of light. In this connection the remark (*op. cit.*, p. 47) of Professor Carpenter may be cited, "there is good reason to believe that the limit of perfection (in the objective) has now been nearly reached, since everything which seems theoretically possible has been actually accomplished."

On the other hand, there are authorities who assert that lines much closer than the $\frac{1}{85000}$th of an inch are resolvable. A few years since Messrs. Harrison and Sollitt published (*Microscopical Journal*, vol. ii., p. 61, 1854) their measurements of the striæ of several diatoms, assigning to Amphipleura pellucida striæ as close as the $\frac{1}{120000}$th to $\frac{1}{130000}$th of an inch. These measurements have recently been repeated, and with exactly the same results, by Mr. Sollitt alone (*Mic. Jour.*, viii., p. 51, 1859), who furthermore expresses the opinion that striæ as close as the $\frac{1}{175000}$th of an inch, can, with proper means, be seen. Mr. Sollitt's measurements have been adopted in the Micrographic Dictionary (1860) and most of the modern works on the Microscope, no one, Professor Carpenter (*op. cit.*, p. 188) excepted, suggesting a doubt as to their accuracy; on the contrary, their correctness seems to be expressly recognised by Dr. G. C. Wallich ("Ann. and Mag. Nat. Hist." for February, 1860).

Such being the conflicting testimony and opinion of distinguished microscopists on the capacity of the modern objective for separating lines, it is somewhat surprising—in view of the high state of perfection now attained by the microscope, and of the number of its zealous devotees—that so few experiments have been made bearing on this interesting point.

As a contribution toward that object, we propose to offer presently an analysis from actual measurements, as far as we were able to carry them, of one of those "marvels of Art," Nobert's Test Plates. In such investigations the quality of the instruments used being all-important, we would state that the optical apparatus at our command was ample, consisting of a first-class Smith and Beck microscope stand, a Tolles' $\frac{1}{30}$ objective of 160° angular aperture,—an objective of rare excellence in all

respects,—besides $\frac{1}{12}$ths and $\frac{1}{16}$ths of other eminent opticians, both English and American; also a solid eye-piece micrometer by Tolles, and an improved cobweb micrometer of Grunow's accurate workmanship. Smith and Beck's stage scales furnished the standards for fixing the micrometrical values of the eye-pieces. By means of Tolles' amplifier, an achromatic concavo-convex lens between the objective and the eye-piece, an amplification (by the standard of 10 inches) as high as 6000 times was obtained. This high amplification, with sunlight variously applied after passing through a small achromatic lens of long focus, was effective in reso ution, and essential to the distinct counting under the micrometer, of the lines of the test plate. The test plate used consisted of 30 bands of lines, each band varying but little from the $\frac{1}{2000}$th of an inch in width, and having its lines a uniform distance apart. On one end of the plate is engraved by Nobert, in parts of the Paris line, the distance apart of the lines composing the first band, and thence on, the distance between the lines of every fifth band, as in the second and fifth columns of the following table:—

Band.	Par. line.	Eng. in.	Band.	Par. line.	Eng. in.
1	0·001000	$\frac{1}{1124\frac{1}{8}}$	20	0·000167	$\frac{1}{674\frac{1}{3}}$
5	0·000550	$\frac{1}{2047\frac{1}{2}}$	25	0·000143	$\frac{1}{787\frac{1}{2}}$
10	0·000275	$\frac{1}{4094\frac{1}{3}}$	30	0·000125	$\frac{1}{900\frac{1}{4}}$
15	0·000200	$\frac{1}{5625\frac{1}{7}}$			

We add the third and sixth columns, giving the distances in parts of the English inch found by multiplying the decimals in the second and fith columns by ·088815.

Analysis of Nobert's Test Plate of Thirty Bands.

Bands.	Lines in each band.	Parts of an English inch.	Bands.	Lines in each band.	Parts of an English inch.
1	7	$\frac{1}{111\frac{1}{10}}$	16	30	$\frac{1}{357\frac{1}{19}}$
2	8	$\frac{1}{130\frac{1}{62}}$	17	31	$\frac{1}{386\frac{2}{23}}$
3	9	$\frac{1}{153\frac{1}{72}}$	18	32	$\frac{1}{621\frac{1}{53}}$
4	10	$\frac{1}{179\frac{1}{60}}$	19	33	$\frac{1}{633\frac{1}{28}}$
5	12	$\frac{1}{202\frac{1}{24}}$	20	34	$\frac{1}{669\frac{1}{47}}$
6	13	$\frac{1}{232\frac{1}{87}}$	21	36	$\frac{1}{680\frac{1}{47}}$
7	15	$\frac{1}{277\frac{1}{05}}$	22	37	$\frac{1}{719\frac{1}{60}}$
8	17	$\frac{1}{322\frac{1}{50}}$	23	38	$\frac{1}{731\frac{1}{90}}$
9	20	$\frac{1}{377\frac{1}{92}}$	24	40	$\frac{1}{742\frac{1}{58}}$
10	22	$\frac{1}{406\frac{1}{36}}$	25	41	$\frac{1}{762\frac{1}{00}}$
11	24	$\frac{1}{450\frac{1}{63}}$	26	42	$\frac{1}{781\frac{1}{05}}$
12	25	$\frac{1}{473\frac{1}{31}}$	27	43	$\frac{1}{812\frac{1}{13}}$
13	26	$\frac{1}{500\frac{1}{00}}$	28	44 ?	$\frac{1}{839\frac{1}{17}}$
14	28	$\frac{1}{552\frac{1}{10}}$	29		$\frac{1}{863\frac{1}{34}}$
15	29	$\frac{1}{535\frac{1}{00}}$	30		

The figures in the third and sixth columns, showing the distance apart of the lines in each band, are the mean of numerous and slightly variant trials, particularly on the higher bands. Up to the twenty-sixth band there was no serious difficulty in resolving and ascertaining the position of the lines, but on this and the subsequent ones, spectral lines,[1]—that is, lines each composed of two or more real lines,—more or less prevailed, showing that the resolving power of the objective was approaching its limit. By a suitable arrangement however, of the illumination, these spurious lines were separated into the ultimate ones on the whole of the 26th and very nearly on the whole of the 27th band; but on the 28th, and still more on the 29th, they so prevailed that at no one focal adjustment could more than a portion (a third or a fifth part) of the width of these bands be resolved into the true lines.

The true lines of the 30th band we were unable to see, at least with any degree of certainty; still, from indications, we have no doubt they are ruled as stated by Nobert.

It will be observed that our measurements of the lines on the 1st, 5th, 10th, 15th, 20th bands vary somewhat from Nobert's registration on the plate, as given in the first table above. Such discrepancies are to be expected, and by microscopists familiar with operations of this kind, are looked upon as unavoidable; but that on the 25th band is rather large to be accounted for in this way. We are unable to explain it, and can only say that our repeated measurements of it were very carefully made.

These experiments, together with those of others before noticed, induce us to believe that the limit of the resolvability of lines, in the present state of the objective, is well nigh established; but that this limit may be carried somewhat higher we are not prepared to doubt since the handsome advance lately achieved by Mr. Tolles in his $\frac{1}{30}$—combining wide aperture, fine definition, and high amplification—shows that the objective had not, as we were inclined to think, reached the stationary point.

The theoretical view of this question,—that is, what may be the closest approximation of lines, consistent with their separation under the microscope—we leave to those competent to the task, by whom, it is to be hoped, we may be favoured with further information on this point.

With regard to the striation of diatoms, an opinion generally prevails that the number of striæ on a given portion of a frustule varies among individuals of the same species, within wide extremes. This opinion is probably traceable in part to one of the earlier publications on the subject, the paper of Messrs. Harrison and Sollitt before referred to, wherein (as in the more recent paper of Mr. Sollitt) measurements of several diatoms are given showing great variableness in their striation. To these gentlemen much credit is due for their discovery of high markings, before unsuspected, on certain diatomaceous frustules; their measurements, however, and the alleged variableness of these markings we have not been able to verify, as will be seen by the following extract from our paper on this subject:—

	Number of striæ in ·001".		
	H. and S.	Sm. Syn.	S. and W.
Navicula rhomboides .	60 to 111	85	70
Pleurosigma fasciola .	50 to 90	64	52 to 56
Pleurosigma strigosum .	40 to 80	44	42
Nitzschia sigmoidea . .	105	85	70

Many frustules of this species, from different localities, have been measured by us, and always with the same results. Pleurosigma fasciola has been specially designated by Mr. Sollitt, and also by Dr. Wallich, as very inconstant in its markings. Of this diatom we are fortunate in being supplied with abundant specimens, from various localities in England, particularly from the neighbourhood of Hull. Several hundred valves, not a few under $\frac{1}{300}$th of an inch in length, were measured, and on no one were found striæ less than 52 or more

[1] The tendency of lines near the limit, either way, of the objective's resolving power, to run into each other and produce spectral or spurious lines, is readily shown by a low objective on the lower bands. Hence, the mere exhibition of lines is not always conclusive evidence of their ultimate resolution. A practised eye will generally distinguish the false from the true. Recourse to a higher objective often accomplishes the same; but when these fail, the micrometer only, together with a previous knowledge of the actual position of the true lines, can determine whether the lines exhibited are real or spurious. A $\frac{1}{12}$th or $\frac{1}{18}$th will show the three or four highest bands on this plate regularly and beautifully striped with lines much coarser than the true ones; the same with the $\frac{1}{30}$th on the last band.

*

than 56 in ·001″, much the larger number being 54. A similarly uniform striation has always been observed among the individuals of many other species examined by us.

To such uniformity of striation Amphipleura pellucida forms as yet no exception; this diatom is still a "res vexata" among microscopists; neither the striation nor the structure of its frustule is at all satisfactorily understood. The record of its striation is found to be thus:—In 1854 Messrs. Harrison and Sollitt's measurements made its striæ 120 to 130 in ·001″; Professor Carpenter (1856) first suggests the probability of some error in these measurements; the writers of this paper declared themselves (this Journal, March, 1859) unable to glimpse the striæ; Mr. Sollitt (*Microscopical Journal*, Oct., 1859) measures them again and finds them still as low as 120 to 130 in ·001″, but gives it as the opinion of Mr. Lobb that "even those figures are too low, and that they ought to be set down at 140 in ·001″; in the same Number of the *Microscopic Journal*, Mr. Ryland "sees striæ, but much more distant than the 130 in ·001″ of the Hull microscopists;" lastly, Mr. Hendry states (*Microscopic Journal*, July, 1860) that he has "come to a satisfactory conclusion that it is a sad misrepresentation to set down the lines so high in the scale as 130 in ·001″, and that on a few shells lines may be counted at 42, and many at 60, 79, and 80 in ·001″." A perplexing record, truly! reminding one of the celebrated Torbane Hill coal case (*Microscopic Journal*, ii., p. 64.)

It is our impression, notwithstanding these conflicting statements, that the diatom before us presented to all these gentlemen the same appearances, but their interpretation of these appearances have been widely different.

The testimony of our objectives, as we understand it, seems to indicate that this diatom has a minutely and irregularly broken-up surface, which, even on the same valve, can be made to show an apparent striation, varying from moderately coarse to extremely fine, according to the obliquity or intensity of the illumination, and to the grade, whether low or high, of the objective used, thus proving beyond question, that the exhibition is illusory. In numerous trials, particularly on fine English specimens from Hull, sent us by Mr. G. Norman, we have entirely failed, with glasses, too, of unsurpassed excellence, to bring out regular, distinct, and unmistakeable striæ, such as would be at once so recognised by an eye practised on the striæ of other diatoms.

After all, it is not improbable that true striæ yet unresolved, may exist on the valves of this species, and, furthermore, that the apparent striæ of different observers may be similar to the spectral or spurious lines before noted as occurring on the bands of Nobert's Test Plate, when examined by an objective incapable of resolving them.

A summary of the foregoing may be briefly stated thus,—that our experiments lead us to believe:—

1. That lines on Nobert's Test Plate, closer together than about the $\frac{1}{87000}$th of an inch, cannot be separated by the modern objective.

2. That no true striæ have yet been seen on the valves of Amphipleura pellucida.

3. That the alleged variableness in the striation of diatoms among individuals of the same species has been greatly exaggerated; on the contrary, we find a remarkable uniformity, thus sustaining the opinion of Professor Smith ("Synop. Br. Diat." v. 2, Introd., p. 26), that for characterising species "striation is the best guide."—*American Journal of Science.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 20, 1861.

W. De la Rue, *Esq., in the Chair.*

(Continued from page 122.)

After the paper by Dr. Roscoe was read, the following discussion took place:—

The Chairman: I am sure, gentlemen, you will agree with me that we are always grateful to those philosophers who, from time to time, are willing to bring before us and recapitulate not only their own discoveries but the discoveries of others. The fact is, science is so rapidly advancing, that it is necessary from time to time to halt and to take a retrospective view, and when we do halt, we find ourselves accompanied by a crowd of facts which have broken down the artificial barriers which were formerly raised up to separate one science from another, and it is quite necessary to re-arrange those barriers. It is not an uncommon thing for the physicist to tread upon the ground which a chemist thinks belongs to him, and for the chemist to tread upon the ground of the physicist. Now, we have the chemist occupying the ground of the astronomer, and if the astronomer wants to know something of the constituents of the heavenly bodies, he must come to the chemist. The physicist and the chemist have brought before us a means of analysis so wonderfully exact that, as Dr. Faraday recently said, if we were to go to the sun, and to bring away some portions of it and analyze them in our laboratories, we could not examine them more accurately than we can by this new mode of spectrum analysis. Dr. Roscoe has shown us that Bunsen has been able by its means to discover two new metals which exist only to the extent of five grammes in forty tons of a mineral water—that is, one part in a hundred millions of substance. Only conceive what refinement of analysis and methods of investigation we have now at our command. As we know, Kirchhoff and Bunsen have shown with the greatest probability, that there are certain metals known to us upon the earth existing in the sun's atmosphere. Professor Roscoe has told us this evening that the methods are applicable also to the discovery of the gaseous constituents—not necessarily metals in a gaseous state, but the ordinary gaseous bodies. Professor Faraday has recently given us another proof of the advantages of this method of observation. But I will not occupy your time, gentlemen, by any remarks of my own. There are very many who have given their attention to this subject, and who, I am sure, can throw considerable light on the investigations, and give us very valuable suggestions; besides which, I am aware that Dr. Roscoe is willing to show in a palpable manner the very refined methods which he has recently described, and, therefore, gentlemen, I will first ask you to return your thanks to Dr. Roscoe, and then I will ask any gentleman who may have anything to say on the subject to make his remarks.

Dr. Miller: By way of starting the discussion, I will first offer a few remarks. No one can have listened to this exceedingly interesting discourse of Dr. Roscoe without feeling the great debt which we owe to those philosophers, Kirchhoff and Bunsen, who have just opened up before us so vast a field. I can only say, that one or two points have struck me since reading their papers which have induced me to make some additional experiments, and I will mention one or two points which have occurred to myself in discussing the subject. I have lately made some experiments with Ruhmkorff's electric coil. I have experimented with one of low power. I used a peculiar arrangement which indicated a difference of power between the two wires which are submitted to experiment. For instance, in the case of platinum the sparks produced are different in length

according to the power which is employed. It is well known from the investigations of Mr. Gassiot, that the negative pole becomes hotter than the other. Bright lines project half way across the luminous field, and those correspond in their starting point with the negative terminal; and on reversing the current, the position of the lines is reversed also, showing that it accompanies the direction in which the current is passing. If then, having put this to the test, you raise the heat by a spirit lamp you get the whole distance traversed by the bright lines, fully corroborating the remark which was made by Dr. Roscoe, that these appearances are solely due to those portions of the metals which are in a vaporous condition. The temperature is not sufficiently raised to establish the whole breadth of the band. There is also another point which struck me incidentally, and which I will mention, if I may be excused for making these desultory remarks. In experimenting with magnesium, Dr. Roscoe remarked that it was not easy to get the magnesium spectrum, obtained from the common salts of the metal. There is a little artifice which may be used, and that is, adding some common salt, by which you facilitate the volatilisation of the magnesium. The definite nature of the light given out by the sodium prevents any confusion in the results, and it enables you to get sufficiently well the lines of the other metal. In experimenting with magnesium wire, if at the same time you let daylight through, certain lines of the magnesium spectrum will be seen to correspond with the lines *b* in the solar spectrum.

Dr. Frankland: I am sure, Sir, there can only be one opinion among the Fellows of the Society as regards the beauty and usefulness of this great instrument of analysis which has been placed in our hands by Bunsen and Kirchhoff, and I trust we shall now see our way very clearly to use it. I wish to ask one question of Dr. Roscoe for my own information, and possibly it may contribute to the information of others. I was not here when the Lecture commenced, so possibly the question may have been answered. I have recently read, with very much interest, the beautiful researches which Dr. Miller made some sixteen years ago upon this very subject. It is really wonderful that sixteen years ago we had the real pith of the whole of this matter thrown before us, but up to the present time we have been unable to use it. I will not acquit Dr. Miller from being partly to blame, for, perhaps, he himself ought to have shown us the practical way of employing the instrument at the time it was revealed to us. But in these experiments, I think, if I am not mistaken,—and Dr. Miller will set me right if I am mistaken,—he showed that one and the same element did not yield in all forms of combination the same spectrum. Now, I wish to know how far experiments have been made upon the different metallic compounds, or upon the different salts of the metals, as to whether they really do yield the same spectra as the uncombined metals themselves. Dr. Miller found that nitrogen, for instance, produced certain spectra which were visible in perhaps one or two of its compounds, which were totally invisible in its other compounds with oxygen. Chlorine, again, produced a distinct spectrum, which was visible, I think, in nearly all its compounds with oxygen, but in one or two this spectrum was very materially changed. Now, I think it would be desirable, at the outset of our endeavours to use this process, to investigate this subject, so as to be as well acquainted as possible with the various metals; therefore, I wish to know from Dr. Roscoe how far such experiments have yet been made—how far we can rely upon these spectra as being in all cases true indications of the presence or the absence of what we are seeking for.

Dr. Roscoe: In answer to Dr. Frankland's very important question, I should say, to begin with, as far as regards the alkalies and alkaline earths, there can be no doubt that all those salts which in the colourless flame are volatile, give the same spectra; and if we take the sulphate, or chloride, or nitrate, we do not see, with the instrument that Bunsen and Kirchhoff propose to use, any difference in the spectra of the different salts of the alkalies and alkaline earths. I imagine the explanation of what Dr. Frankland has just pointed out is to be found in the fact, that those substances, which at the ordinary temperature are gases, or which at a temperature very much lower than the temperature of the flame become gases, require a very much higher temperature to become luminous and give out light, than those substances which are either solid at the ordinary temperature, or very much less volatile. Now, I really cannot speak positively upon this point, nor do I think the subject is so far advanced that we can have positive information on it, but I do not myself suppose if we take the nitrate of strontium and the chloride of strontium, for instance, that in the spectra obtained by the electric spark, we should see exactly the same bands produced by the two compounds. I imagine that we should see in the one case something due to the presence of nitrogen, and in the other case something due to the presence of chlorine. How far this may interfere with the use of the spark, of course, I am not in a position to say. With regard to the beautiful experiments of Dr. Miller, published in the year 1845, I believe that the differences which Dr. Frankland alludes to were due to the absorption of those different vapours. I won't be quite sure whether that is the case. Dr. Miller will be able to give us positive information. I believe that Dr. Miller found that peculiar bands due to the oxides of chlorine were not the bands produced by the luminosity or by the ignition of the chlorine, but dark bands produced by absorption, and in that way, of course, he found different oxides of nitrogen gave different results, some of which gave coloured bands. I do not know whether Dr. Miller observed the luminous spectra of those substances. Thus NO_3 and NO_4 gave bands which the elements themselves did not give.

Dr. Miller: I may state, Sir, in reply to the interesting statement which has been made by Dr. Frankland, that it seems to me that there is a distinction between those bodies which are metallic and those which are not metallic. In the case of the non-metallic compounds, especially oxides, we have a different series of lines to those furnished by the elements in their uncombined state. For example, notwithstanding the green colour of chlorine, pure chlorine gives no lines to ordinary observation, and hypochlorous acid gives no lines. Chlorous acid and the peroxide of chlorine both give lines, and lines which even appear to coincide. In the case of the peroxide of nitrogen there is a series of lines characteristic of that vapour, which Dr. Gladstone has recently most elaborately investigated. I was not able at that time to isolate nitrous acid, corresponding with the chlorous acid, with such a degree of accuracy as would make the comparison worth anything As has been stated, there is certainly a difference in the bodies, according to their state of combination. The appearance of lines is not always dependent upon colour. In a great many cases coloured vapours appear to give no lines; in other cases they do give lines. The intensity of the lines does not depend upon the intensity of the colour. A very curious illustration of that appears in the contrast between bromine vapour and the peroxide of nitrogen. Bromine gives a series containing a great number of lines, which look almost as if they were ruled with a ruler from one end of the spectrum to the other, and each of these ruled lines consists of an infinity of finer lines. In the case of iodine a similar appearance is observed, but it is much more graduated. I do not mean to say that they fall with the same intensity; but there is the same regularity and the same kind of gradation from darkness to light. Hydrobromic acid and hydriodic acid both give colourless vapours entirely destitute of lines, except so far as the lines are produced by ordinary solar light.

Dr. FRANKLAND: Would it not follow that if any vapour or gas was incapable of absorbing those rays of a particular refrangibility it would also be incapable of emitting them upon ignition? I think if the theory now propounded would account for those lines, such would be the case. It is only because these particular vapours possess the property of taking up those particular rays which move at a certain velocity that they are capable of absorbing to a great extent the light from the nucleus of the sun, and it is almost proved that when a vapour is incapable of absorbing certain rays of light, it is incapable, also, of emitting those rays at those particular temperatures, at all events.

Dr. MILLER: There is one observation which I should make. In experimenting with the salts of metals I generally use chlorides, because they are more soluble in alcohol. They were dissolved in that liquid, and in this way their flame could easily be examined. I always found that in the case of the chlorides there was a band about the green, and I attributed that to the escape of chlorine. I found in all cases where I used a chloride that I got this band, and I did not get it in other cases where I did not use a chloride. I did not investigate it with a sufficient degree of minuteness to say that it was due to the chlorine or not, but I thought it was due to the escape of the chlorine. I have formerly stated that as my opinion. The effect of the absorptive influence of these compound gases upon light it would be very difficult to ascertain, because none of these compound gases will stand a very high temperature without undergoing decomposition.

The CHAIRMAN: There is one matter, gentlemen, which has struck me in this discussion, and which it is necessary to bear in mind; that is, that with respect to light we do not see all the light, that is to say, all the force emitted by a luminous body, or a body in a state of incandescence, or having a temperature different from that which it has in its normal state. We do not see all the effect, and it is very possible that some of those luminous or incandescent bodies may give off rays which would be visible to a sensitised photographic plate; and that their vapours might also stop off a portion of those rays. Hence, I think it is very desirable that the experiments should be extended in that direction. I do not at all put this forth as an idea of my own, because I am quite ready and desirous to attribute it to the philosopher who propounded it, and that was Professor Faraday. Probably the prosecution of experiments in this direction might lead to the detection of bands which are not visible in the luminous part of the spectrum; I dare say it has struck other philosophers who are pursuing the subject, and it is very likely that investigation will be carried on in that direction.

Mr. HERSCHEL: There is a question that I should like to ask Dr. Roscoe, if I may be allowed to do so, about the absorption of the sodium ray by the sodium flame. It seems to me that by the explanation given in which it is compared to the action of a sounding-board, that instead of the vibrations being absorbed when they came to it, they ought, on the contrary, to be heightened in intensity, it has always been difficult for me to understand the usual explanation.

Professor FARADAY: It has always seemed to me a very difficult thing to see how of necessity there was a depression of the light instead of an increase and exaltation of it.

Dr. ROSCOE: It seems to me that Mr. Herschel has hit the nail on the head. It is a very difficult point to answer, and I really do not feel myself to be able to give a satisfactory explanation of it. It is quite true that the simile of the sounding-board is not quite an exact one, because the vibration is taken up in the one case, and in the other case it is absorbed. I cannot explain it at all, and I don't know that it ever has been explained. About the fact of the absorption, I have no doubt at all. It appears to me a sort of interference, because certainly the intensity of the light is diminished, and not increased. The simile of the sounding-board I believe was first given by Mr. Stokes, simply as one which would help us to form an idea how one body, which is capable of taking up a vibration, may be set in vibration by another body at a distance, undergoing the same vibration. It is, however, a matter which I must leave to physicists to explain.

Dr. MILLER: May I, Sir, venture a very crude suggestion upon this matter, as it has been started? May it not arise in this way?—If it is a case of interference, as Mr. Roscoe says, it may arise from the fact that in particular positions of the flame the phases of vibration coincide, and then we have increase; and that in other positions of the flame which is continually flickering, the phases of vibration vary, and neutralise each other. Thus, we may get the black in the one case, and the brightness in the other. I have repeated the experiments, and I have found in some cases an increase of light by interposing the electric light between the sodium light and the eye, and in other cases there has been a dark line produced. Now, may it not possibly arise from the fact of the flickering of this sodium light giving sometimes vibrations which coincide, and therefore reduplicate the light, and at other times the reverse, thus producing darkness?

Dr. GLADSTONE: I think, Sir, I may be permitted to say a word upon this subject, although I did not hear the discourse; for it so happened that it was necessary for me to leave the room to lay before the Royal Society a communication upon the same subject. I had to go and see how they got on there. My paper was read, although there were twenty-one papers before the Society, and there was a vigorous little discussion upon it, so we have been talking in another place upon just the same subject. There are one or two points which have been started in the discussion, which I may just allude to. A thought has been propounded by Dr. Frankland whether a gas which gives no lines of absorption, ought to emit lines when it was heated very strongly. Now, whatever we may think of that theoretically, we know in practice that it is absolutely not so, because nitrogen and oxygen and other gases are in the atmosphere, and in that condition. The second of those maps shows certain lines which make their appearance when the sun sinks towards the horizon—when his rays, therefore, pass through a large stratum of air. Now, it occurred to me that we might find out what constituent gave out these lines, by comparing those dark lines, or lines of absorption, with the brilliant lines given out when various constituents of the atmosphere are strongly heated. Therefore I compared the position of those with the position of the bright lines which appear when nitrogen is strongly heated in tubes by the electric spark, as shown by Angstrom and Plucker. I made the same experiments with oxygen; and I examined also the lines given by the oxy-hydrogen flame, and by carbonic oxide burning in the atmosphere, thinking these two flames might consist, more or less, of incandescent nitrogen and oxygen. The result of this comparison is, that I found no one point of similarity between those lines limited by these gases when strongly heated, and the lines which appear in the atmosphere when the sun's rays go slantingly through it. The conclusion, therefore, is that two or three hundred miles of mixed oxygen or nitrogen gases, do not exhibit any indication that we can appreciate of absorption bands in the same position as oxygen and nitrogen would emit rays, if strongly heated. The same holds good of water and carbonic acid. Hydrogen is the only doubtful gas in the matter; and there may be three of these particular bands which may possibly be due to hydrogen, but I don't think so myself. Another point which I may allude to is this, that we have in this way a most powerful means of showing the absence of certain constituents from the atmosphere. We can all see that if such a substance as peroxide of nitrogen—(and here I must correct a statement of Professor Miller, who described me as having

examined this particular gas: it was not examined by me, but by Sir David Brewster long ago, and all the credit which I can claim is that of putting Brewster's investigations together)—but as these lines do not coincide with the dark lines that appear in the spectrum of the sun, we see that there is none of this gas in the atmosphere, or the moisture of the atmosphere would resolve it into other things. But we have the means thus of excluding bromine and iodine from the atmosphere. We have been told by Dr. Miller that these two gases produce most beautiful lines of absorption, which cannot be mistaken when they have been once seen. A small quantity of either will produce these lines. Now, these lines do not appear, and no trace appears in the spectrum of the sun. I calculated the matter roughly, and I found that we should be able to distinguish in this way one part of bromine in 950,000,000 parts of air, and there is not that.

Dr. Roscoe: I can only say one word of thanks to Dr. Gladstone for having mentioned the results of his experiments, which enables me to set myself right before the Society in referring to these spectra. Dr. Gladstone was not in the room when I spoke of them, or else he would have heard that I gave a different account of it, for I only compared Dr. Gladstone's table with Angstrom's table, and saw in it a very fair coincidence, and not having had time to investigate the matter I think it was a very fair assumption to suppose that there really was this absorption by the electric spark; but it appears now that this is not the case, and we must not rely on these drawings, then, but take Dr. Gladstone's own experiments. I only mention this because I stated before that it appears that it was a case of coincidence in the tables published.

Dr. Miller: I think, in reference to the photography of the invisible lines of the spectrum, it should be stated that experiments have already been made in that direction. Becquerel and myself have made experiments on this, and I recollect some time ago seeing some very nice spectra which Mr. Crookes produced of the lines in the solar as well as metallic spectra.

The Chairman: It was not with respect to the photography of the spectrum, but with respect to showing photographically the separation or absorption of certain rays which are photographed when the metallic vapours are produced. It only remains for me now to state that the meeting is adjourned to November 7.

NOTICES OF BOOKS.

Lights and Lighthouses: Report of the Commissioners appointed to inquire into the Condition and Management of Lights, Buoys, and Beacons.

SECOND NOTICE.

In continuation of the remarks on the general subject of this inquiry which appeared on a former occasion in our columns,[1] we have now to pass in review some of the results arrived at, and to point out other promising directions of investigation, which are treated of in detail or suggested by the perusal of the voluminous mass of evidence which has been accumulated by the Commissioners for the purpose of enabling themselves and others to decide upon the best methods of producing and judiciously applying the brilliant lights which serve as beacons on the coasts of the United Kingdom.

The first and perhaps the most important subject of inquiry refers to the character and source of light best adapted to general lighthouse use, and here at once a distinction has very properly been drawn between methods applicable to all localities, and those which are only suitable for illumination on the mainland, or at most to those only which have the advantage of occasional intercourse with commercial districts in the immediate neighbourhood. Thus it is found easy to apply gas for the illumination of the harbour light at Leith Pier Head, but the carrying out of the same system at the Eddystone would, from its isolated position, be attended with much greater difficulty.

In the present state of the subject, it seems to be generally admitted that the use of the oil-lamp is on the whole the most satisfactory, especially in remote situations, but as the result of a canvass of the scientific opinions, it appears that whilst the majority concede this as an established proposition, twelve among the fifty authorities consulted give their votes in favour of other means of illumination. From these we select the following as representing the systems which appear most worthy of comparative trial. The Earl of Rosse recommends the substitution of the lime light, which recommendation is also confirmed by the opinions of Sir John Herschel, Mr. A. H. Renton, C.E., and Mr. William Austin, C.E. We may here remark that by a recent announcement in the *Times* the public is informed that a trial of the lime light was commenced at the South Foreland Lighthouse on Monday, the 26th of August last. Mr. Copcutt recommends that experiments be made with the Fitzmaurice light. Sir David Brewster advocates the use of a gas light fed with pure oxygen. Admiral Fitzroy and Dr. Robinson, of Armagh, suggest the application of oxygen in conjunction with the present oil-lamp. Mr. James Mackintosh recommends a trial of the Bude light. The various modifications of the electric light as proposed by Dr. Watson and Professors Holmes and Way have each their advocates; but on this head we refer with confidence to the reports rendered by Professor Faraday to the Trinity Board. The particulars relating to these inventions form a conspicuous section of the scientific evidence, and to these we propose again to revert. Dr. Robinson suggests that, in the event of the magneto-electric light being found too expensive for general use, the apparatus should nevertheless be provided, and used only during the prevalence of fog or snow. The same gentleman points out the advantage of the naphthalizing process employed as a means for increasing the brilliancy of gas, whenever circumstances should render the use of this source of light possible and desirable. Paraffin oil, as a substitute for "refined rape," is preferred by Dr. Joule for use in lighthouses easy of access. Suggestions have also been made in reference to the use of certain pyrotechnic mixtures for producing lights of great intensity; but the objections incident to the employment of this class of materials appear almost insuperable, on account, not merely of the uncertainty in regard to regularity of burning, but mainly by reason of their combustion being invariably attended with the formation of sublimates, which are liable to condense on the inner surfaces of the glass lanterns, and thus materially obscure their transparency.

It is to be regretted that the recommendation to consult Mr. Babbage, who has made many points in reference to lighthouses the subject of particular study, does not appear to have been acted upon by the Commissioners, although the advantage of taking this course was suggested independently by the Earl of Rosse, Sir John Herschel, and Professor C. P. Smyth.

Among the propositions which appear to offer the greatest advantages for illuminating purposes the lime-light, at present under trial at the South Foreland, and the magneto-electric light of Professor Holmes, formerly tried at the same station, have been deemed those most worthy of careful comparative experiment. In order to prepare with facility the gases necessary for the first of these methods, it is recommended to employ the recent

[1] Chemical News, Vol. iv., p. 37.

suggestion of MM. Deville and Debray for procuring oxygen by the decomposition of sulphuric acid by heat; and also to use as occasional substitutes for pure hydrogen ordinary coal-gas and the highly-carburetted gas afforded by the destructive distillation of oil. These when not produced on the spot are to be conveyed thither in strong iron cylinders under powerful compression. It is manifest, therefore, that the employment of lamp-oil possesses in a single particular—that of portability—an advantage over the newer system, especially when applied in difficultly accessible positions.

With reference to the burning of coal as a means of producing light, it is interesting to compare the results obtained by the old fire-basket of the last century with those furnished by the combustion of gas prepared from one portion of coal by the consumption of another; and this system again with that which converts a given weight of coal burnt under a steam-boiler into motive power, and by the employment of this force in the rotation of magnets to produce an equivalent in the shape of the magneto-electric light. The practical solution of this and other equally important problems will not, we trust, be long deferred. These directions of scientific inquiry have a charm not only for Faraday, who introduced them as the subject matter of a lecture at the Royal Institution, but must always be appreciated by those who feel a general interest in these questions in economic science.

As to the optical apparatus, the dioptric system, invented and first employed in France, has been gradually adopted in our own country, and in Scotland some improvements have been made in it. There is, however, this important difference: in France the new apparatus was adopted throughout the whole lighthouse service; and in Spain and the States of America it has lately been exclusively adopted in the great reformation of their lighthouse system just effected by the Governments of those countries; but in the United Kingdom the old reflectors have only been replaced from time to time by the refracting apparatus; and the Board of Trade now lay down the principle that the expense should only be incurred when the reflectors are worn out. A judicious combination of metallic reflectors with the prismatic (dioptric) apparatus of Fresnel will often prove the most efficient arrangement, especially when the light is a fixed one and placed in a position where no illumination is required on the land side.

The distinguishing colours most suitable for lighthouses are red, green, and white; it would appear that white and red have greater fog-penetrating power, but Sir David Brewster justly remarks in reply to this question, that "it is not a matter of opinion, but should be experimentally determined." Sir John Herschel writes, "pale red and pale green give a good contrast, but there is a chance of colour-blind persons not perceiving it." Has the necessity for examining the eyesight of mariners employed on the watch been sufficiently appreciated? Dr. George Wilson's researches on the subject of colour-blindness have proved that a very notable proportion of individuals are in some slight degree liable to errors in attempting the discrimination of colour.

Mr. George Gladstone calls attention to the beneficial results likely to arise from the extension of a system of telegraphic communication between lighthouse stations; whereby many disasters at sea might be avoided if it were possible to communicate by a code of signals, the information of acoming storm to all vessels within sight.

In concluding our notice, we cannot refrain from offering willing testimony to the value of the labours of Dr. John Hall Gladstone in connection with the scientific questions involved in the inquiry. The suggestions referring to points still requiring investigation have been drawn up by this gentleman in a manner which seems to have exhausted the whole subject.

NOTICES OF PATENTS.

A New Paste made from Wood, to be Used in the Manufacture of Various Articles. C. Stevens. A Communication.

This invention refers to the manufacture of a kind of pulp or paste from the fibrous tissue of wood, the material so prepared being capable of adaptation to many purposes similar to those for which papier maché is at present employed. The treatment to which the wood is subjected may be generally described as follows:—The shavings of soft woods, as poplar, birch, lime, and fir, are used by preference; these are boiled in a solution of caustic soda for a time sufficient to effect the tolerably complete separation of the woody fibres, which are then taken out, drained, and allowed to remain for several days in a mass until fermentation has set in, when the disintegration of the fibres will by this means have been further facilitated. During this operation the mass will require frequent watering to prevent the formation of a hard outer crust upon the glutinous material. Eventually the structure of the fibres will become soft and supple, and may then be further broken up by a kind of tearing engine, constructed of toothed rollers and surfaces, which is fully described in the specification. The washing and after treatment are very similar to the processes ordinarily followed in the making of pulp for paper.

The system of manufacture here defined, yields a description of pulp certainly inferior to that usually employed in paper-making, but which will nevertheless be suitable for moulding into shapes and for a rougher class of purposes where the production from cotton rags would be met by insuperable difficulties on account of cost.

Tanning Hides and Skins. J. H. Johnson. A Communication. (Not proceeded with.)

It is proposed to employ for the purpose of tanning hides a new vegetable decoction prepared from maruta cotula, to a gallon of which are added about four ounces of catechu, and two ounces each of alum and common salt. In this mixed tan-liquor the skins or hides, with or without hair upon them, are to be immersed, and there left for a period determined by the thickness of the skins, and by other circumstances which ordinary experience will dictate.

Sir Humphry Davy was, perhaps, the first to show that catechu alone could be employed as a tanning material. We are unacquainted with any special properties possessed by the vegetable decoction referred to, which would render advantageous its employment in conjunction with the foregoing.

Manufacture of Fuel. A. G. Lasserre, Bordeaux.

The intention of the patentee is to agglutinate small coal, coke, or anthracite into blocks or lumps of various shapes and dimensions convenient for employment as a compact kind of fuel. In carrying out this process the inventor heats the small coal to a softening temperature in a closed oven, and then, by a suitable mechanical contrivance, effects the complete admixture of the same with either coal tar, pitch, or resin, and moulds the hot plastic material into blocks of the shape required. The treatment of peat, also, in a similar manner is contemplated in the specification.

The general principle upon which the present process is based has repeatedly formed the subject of previous patents for the same object. Many years since the "Patent Fuel" Works were established at Swansea and elsewhere with precisely the aim of converting the dust and small coal into serviceable blocks of fuel, admirably adapted for shipping and other purposes where economy of space

is of the highest importance. By operations almost precisely identical, small coke, also, is daily reconverted into larger masses by the aid either of pitch, tar, resin, asphalte, or similar materials, the number of which is only exceeded by the perfect host of specifications descriptive of these manifold patented processes.

Portland Cement. J. Lark, Strood. (Not proceeded with.)

This invention relates to an improved method of drying the mixed materials (marl and chalk) after their incorporation by grinding with water, and prior to being burnt in the kiln to make Portland cement The moist material is spread out upon the bed of a kind of drying stove, constructed with a series of wrought iron pipes laid underneath, and communicating with a steam boiler, which constitutes the source of heat employed in the process of desiccation. The inventor claims for this system the advantages of greater rapidity in drying, and more uniformity in regard to the degree of heat.

Improvements in Mordanting and in the Manufacture of Products to be Used in Mordants and Otherwise. J. Townsend and J. Walker, Glasgow.

The improvements here referred to consist in the substitution of the hyposulphite and sulphite of alumina to be used in preference to other compounds of this base for the purpose of a mordant, particularly adapted to the dyeing of Turkey red. The specification describes the mode of preparing the mordant from alum and other salts of alumina, and likewise refers to the production of "precipitated antichlore" by double decomposition between the sulphite or hyposulphite of lime and a salt of alumina.

Dyes and Colouring Matters. C. H. G. Williams.
Obtaining Colouring Matters. V. Hall.
Preparing Colouring Matters for Dyeing and Printing. C. A. Girard, Paris.

The patent of M. Girard is that alone which has been proceeded with. It refers to the production of variously-coloured dyes from aniline red by treatment either with aniline or any homologous base.

Mr. Williams' invention relates to the preparation of blue and purple dyes from the organic alkaloids, quinine, cinchonine, strychnine, and brucine; and is partly in continuation of a patent formerly granted to him (April 30, 1859) for the production of dyes from these sources.

The specification of Mr. Hall, of the College of Chemistry, describes minutely the steps taken for the production of colouring matters from the heavy oil of coal-tar, technically known as "dead oil." This is submitted to fractional distillation, and the separate portions severally acted upon with concentrated nitric acid, the nitro-compounds so formed being subsequently reduced by any one of the chemical agents specified, either by sulphide of ammonium, nascent hydrogen, or acetic acid and iron filings.

Grants of Provisional Protection for Six Months.

1748. Joshua Kidd, Strand, London, "Improvements in the manufacture, application, and combustion of gases, and in apparatus connected therewith."

1774. Rees Taylor and Thomas Price, Tydu-Tin Plate Works, Bassaleg, Monmouthshire, "Improvements in the manufacture of tin and terne plates."—Petition recorded July 15, 1861.

1928. Charles Schinz, Offenburg, Grand Duchy of Baden, "Improvements in glass furnaces."

1958. Peter Spence, Newton Heath, near Manchester, and James Mellor, Manchester, "Improvements in separating copper from its ores."—Petitions recorded August 6, 1861.

1972. Richard Jukes, Sheffield, "Improvements in puddling furnaces."

1978. Louis Le Paige, Merxem, near Antwerp, Belgium, "Improvements in treating fatty and oily matters obtained from wash waters to deprive them of their smell."

1983. James Hemingway, Robert Town, Yorkshire, "Improvements in machinery or apparatus for working coal, ironstone, or other minerals."

1985. Joseph Griffin and Charles Griffin, Walsall, Staffordshire, "New or improved machinery for the manufacture or cutting of corks and bungs."

1994. Henry Wilde, Manchester, "Improvements in electro-magnetic telegraphs, and in apparatus connected therewith."

2009. Joseph Jacob, Golden Square, London, "Improvements in producing on porcelain and other ceramic products, on glass, Venetian enamels, and on metallic surfaces, designs in colours, and in gold, silver, and other metals."—A communication fron Franz Kosch, Vienna, Austria.

2013. Christopher Binks, Gray's Inn, London, "Improved methods of, and apparatus for, treating linseed and other oils and fats."

2023. Richard Archibald Brooman, Fleet Street, London, "Improvements in coating wire with copper, silver, gold, or other metal or alloy, in order to prevent oxidation."—A communication from Martin Miller, Vienna, Austria.

2025. Thomas Silvester, West Bromwich, Staffordshire, "Improvements in spring balances or weighing apparatus."

Notices to Proceed.

924. Thomas Miller, Fossoway, Perth, N.B., "Improvements in the method of, and machinery for, preparing india-rubber and other similar gums for insulating telegraphic wires, and in machinery for laying or applying strips of india-rubber and other similar gums or strips of fibrous or textile material on to telegraphic wires."—Petition recorded April 15, 1861.

940. Henry Anthonissen, Brussels, Belgium, "An improved method of making bread and obtaining starch from the materials employed simultaneously."

962. Philippe Mingaud, Rue Laffitte, Paris, "Improvements in obtaining jellies, syrups, and drinks from the tree 'arbutus unedo, or arbousier.'"

1006. Peter Ward, Clouds Hill Villas, Bristol, "Improvements in the manufacture of sulphuric acid."—Petition recorded April 23, 1861.

1019. Charles Stevens, Charing Cross, London, "A new artificial manure."—A communication from Hypolite Louis Marie Planchais, Rue Laffitte, Paris.

1057. Edmund Hamborough Joynson, St. Mary's Cray, Kent, "Improvements is machinery for the manufacture of paper."

1117. William Edward Newton, Chancery Lane, London, "Improvements in the treatment of copper ores."—A communication from Joseph Marie Puisteinne, Paris.—Petition recorded May 3, 1861.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Action of Ammonia on Chlorides.—M. Deherain has communicated to the Chemical Society of Paris the first part of an extended study of the action of ammonia on metallic chlorides (*Bulletin de la Société, &c.* No. iii., p. 51). When chloride of zinc is dissolved in liquor ammonia, the solution on cooling deposits a white crystalline powder, $ZnCl,2NH_3$. The powder dissolved in hydrochloric acid yields, when the solution is evaporated, a well-crystallized salt, $ZnCl,2NH_4Cl$. The ammoniacal liquor which yielded the first salt evaporated at a gentle heat gives another, with half the amount of ammonia, $ZnCl,NH_3$. This salt dissolved in hydrochloric acid, like the former, gives a double salt, $ZnCl,NH_4Cl$. The salt, $ZnCl,NH_3$, when ignited loses half its ammonia, and then forms a yellow,

transparent, gummy mass, which is a very stable compound, $2\,ZnCl,NH_4Cl$. The author adds nothing to our knowledge of the action of ammonia on bichloride of tin. Protochloride of antimony fused in an atmosphere of ammonia yields on the surface the compound $SbCl_3NH_3$. Water decomposes this compound, forming a white precipitate, and leaving in solution the salt $SbCl_54NH_4Cl$. The compound $SbCl_3NH_3$ dissolves in hydrochloric acid, and yields on evaporation brown deliquescent crystals of a very unstable salt, $SbCl_3NH_4Cl$. When ammoniacal gas is carried into the mass of fused protochloride of antimony, a white volatile salt is formed, having the formula $SbCl_32NH_3$. With perchloride of antimony ammonia forms a compound to which Rose assigned the formula $SbCl_52NH_3$, but which M. Deherain's analyses show contains $SbCl_53NH_3$; and another, with 4 atoms of ammonia, $SbCl_54NH_3$. Both of these form crystalline salts when dissolved in hydrochloric acid and evaporated. The author is inclined to regard the compounds of chlorides with ammonia as *chlor amides*, but admits that there are serious objections to the view.

Nitrous and Nitric Acid in the Atmosphere.—Cloez has proved (*Comptes-Rendus*, T. lii. p. 527) the presence of nitric acid by passing air through solutions of the carbonates of potash and lead. In both cases he obtained nitrates. Other oxygen compounds of nitrogen, the author says, are present in the atmosphere, which makes him doubt the accuracy of the ozonometric observations made with iodized papers.

II. ORGANIC CHEMISTRY.

Formation of Fumic Acid.—The formation of fumic acid, so important, apparently, to the nutrition of plants, has received a long investigation at the hands of M. Paul Thenard, the discoverer of it (*Bulletin de la Société Chimique de Paris*, No. ii. page 33), who has come to the conclusion that it is a compound of ammonia or certain ammoniacal salts with vegetable principles. He wetted straw, dry leaves and sawdust with ammonia, and the carbonate and sulphate, and found that it was formed in abundance. He found, also, that when glucose, or sugar, was heated in a tube nearly to the temperature at which it decomposes, and a current of ammoniacal gas was passed, a large quantity of the ammonia was absorbed, and substances produced greatly resembling fumic acid. That formed from glucose was of a brown colour, was soluble in water, acids and alkaline solutions, but insoluble in alcohol. That formed from cane sugar was brown, uncrystallizable, soluble in alcohol and insoluble in water. Carbonic and the other acids dissolved it freely and alkalies precipitated it from the solution. Another body formed with the last had similar properties, but was insoluble in alcohol. The analyses of these three bodies gave the following results :—

	I.	II.	III.
Carbon	52·28	65·66	54·26
Hydrogen	6·38	6·05	5·34
Nitrogen	9·94	19·36	18·78
Oxygen	31·40	8·93	21·61

Similar substances to the above were formed when starch, mannite, cane sugar, or sugar of milk was heated with liquid ammonia in a sealed tube. When syrup was heated with liquid ammonia to 180° Centigrade, carbonate of ammonia, a black liquid and a black solid substance were formed, the two last of a very complex nature. The author speculates on the constitution of these bodies, admitting that he has but incompletely studied them. We do not, therefore, quote his speculations. He mentions a fact, however, which may be of value to some of our readers. A farmer, near Châlons, sprinkles his dung-heaps with ammoniacal gas liquor, and thereby obtains an excellent manure. The gas liquor used in this way producing a much better effect than when applied directly to the soil. M. Thenard examined the dung-heaps and found an abundance of fumic acid, or rather fumate of lime.

MISCELLANEOUS.

Popular Science.—A Mr. S. Holmes, writing to the *Mechanics' Magazine*, a weekly newspaper, which sometimes dabbles in science, favours its readers with the following piece of information :—"It is a proved fact, that the smoker's bugbear—nicotine—being an alkaloid, is instantly decomposed by the acid reaction of the saliva, and assumes the form of a harmless hydrocarburet." This reminds us of the celebrated definition of a lobster by the French *savans;* in two lines there are no less than four blunders—1, the saliva does not decompose nicotine; 2, it is not acid; 3, if it were, it would not form with nicotine a hydrocarburet; and 4, the compound it would form would not be harmless. The same paper, a few weeks ago, devoted an article to sneering at our statement that red-hot carbon decomposed aqueous vapour with formation of two inflammable gases.

The Polytechnic.—Return of Mr. Pepper.—The great services rendered to the cause of popular education by Mr. Pepper, and his untiring zeal in catering for the public amusement, during his former management of the Polytechnic, received a gratifying recognition on Monday evening, in the vast throng assembled to welcome him back to that Institution, and by whom his appearance on the platform of the large hall was hailed with the most enthusiastic plaudits. The subject chosen for the first of a new series of those popular scientific lectures which Mr. Pepper made so distinctive and pleasing a feature in the Polytechnic entertainments, was Ventilation, the discourse being one which, even without the lecturer's rare felicity of illustration and lucidity of explanation, would have been listened to with interest at this sultry season. The Polytechnic is certainly one of the best ventilated places of entertainment in the metropolis, as was shown by the comfortable temperature of the large hall on Monday, while crowded from floor to roof; but the difficulties which have hitherto rendered domestic ventilation unattainable, except by the rough expedient of opening the window, at the risk of the draught disarranging papers, covering furniture with dust, introducing a tormenting wasp, and probably catching cold, disposed every one to listen attentively to Mr. Pepper's exposition of the principles of ventilation, to feel interested in his ingenious experiments, and, we doubt not, to adopt the simple, inexpensive, and efficient apparatus which he recommended, and which has been patented by Mr. Cooke, C.E. The folds of wire gauze affixed to the upper sash prevent draughts by diffiusing the current of air admitted, exclude dust and insects, effectually ventilate the apartment, and are easily fitted. After the lecture the auditory dispersed to view the pictures, sculptures, models, &c., so profusely displayed in the body of the building, and the ever attractive operations of the diver; and the entertainments concluded with the exhibition of a series of beautiful dissolving views, illustrative of a "Voyage down the Stream of Time," commencing with the rock-temple of Abou-Simbel, in Egypt, and terminating with the great fire at London Bridge.

ANSWERS TO CORRESPONDENTS.

Alchemy.—This is too often confounded with the search after the philosophers' stone and the gold-making of the sixteenth and seventeenth centuries. Alchemy was the science of chemistry, and included all those processes in which chemistry was technically applied. To the alchemists we owe modern chemistry and experimental philosophy.

Adulteration of Butter with Lard.—A correspondent wishes to know a ready means of detecting the presence of lard in butter, an adulteration which he is certain is almost universally practised with metropolitan "best fresh" and inferior qualities.

X. Y. Z.—Write to the Secretary, Dr. Odling, Burlington House, Piccadilly. He will give you the necessary information.

THE CHEMICAL NEWS.

VOL. IV. No. 93.—September 14, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. MULDER, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page* 127.)

EVEN were the change which chloride of silver undergoes by the effect of daylight far smaller than it really is, it is quite clear that the estimation of silver by the moist way would yield incorrect results, if during the experiment discoloration were allowed to take place. It is therefore necessary to put all the bottles used during the experiment in cylindrical boxes made of some suitable metal, painted black inside, and to perform the experiment so that the light of the day can only have access to the bottles at the moment of observation, and even then the chloride of silver should not be quite uncovered, but the bottle be left in the metallic box, and a portion of the bottle only lifted out of the box sufficient to give space to inspect the supernatant liquid. When the bottles are to be shaken in the boxes, the necks of the former are covered with a suitable cover, or with a double cap made of black cloth, so as to expose nothing of the chloride of silver to the light during the operation of shaking. That the chloride of silver, when loosing some of its chlorine, is really changed into the already-mentioned violet substance, may be readily shown, for if the bottle containing the chloride, is filled with chlorine gas it can be exposed to the daylight without discoloration.

When heated in a dry state, chloride of silver melts, it loses a little of its chlorine, and undergoes a similar change as when exposed to the light. All quantitative determinations, therefore, both of silver and chlorine, when made by heating and igniting the chloride of silver before weighing, yield a result which is a little below the truth. The white chloride of silver gets the more coloured the more chlorine is expelled. Chloride of silver is to a very great extent insoluble in water. If one-fifth part of a milligramme of silver in solution is added to 200 cubic centimètres of water, which are equal to 200,000 milligrammes, and there is then added as much common salt in solution as is equivalent to the silver, then it will be seen that the liquid is rendered blueish and milky. $\frac{1}{1000000}$th of silver can therefore be recognised as chloride of silver in water; this property is one of the most important in the estimation of silver by the moist way. Four times as much silver, however, is required to distinguish a precipitate. Nitric acid added to the last-mentioned liquid does not produce, as far as can be seen, any diminution of the milkiness or of the precipitate. Chloride of silver, therefore, is not rendered more soluble in water by the presence of nitric acid. This fact, also, is of great importance for the estimation of silver by the moist way. Chloride of silver is rather, although even in small proportion, more soluble in strong nitric acid than in water. When 50 cubic centimètres of nitric acid of a specific gravity of 1·2 are taken, and one-twentieth part of a milligramme of silver is dissolved in this acid, and there is then added as much solution of common salt as is equivalent to that weight of silver, then the temporarily formed chloride of silver disappears. I will describe among the apparatus a dropping apparatus fit for such experiments. In the nitric acid solution mentioned in the last experiment, both nitrate of silver and common salt in solution can produce a trace of precipitate. When strong nitric acid, which contains suspended in an undissolved state a well visible trace of chloride of silver, is diluted with water, it is rendered perfectly clear. Chloride of silver, therefore, is soluble in a rather concentrated nitric acid, but it is still more soluble in nitric acid diluted with water.

Chloride of silver may be said to be equally little soluble in water as in weak nitric acid.

It is impossible to detect in either of these cases $\frac{1}{2000000}$th part of silver; $\frac{1}{1000000}$th may be detected in both cases: therefore, neither water nor weak nitric acid interfere with the estimation of silver by the moist way. But we have not only to deal, when actually experimentalising, with the great insolubility of the chloride of silver, the question also presents itself at what degree of dilution a precipitate can be still perceptible. This may be put without any exaggeration at a dilution of one in 200,000 parts.

Chloride of silver is, to a certain extent, soluble in hydrochloric acid. In case hydrochloric acid is added to the water which contains, in a suspended state, the chloride of silver formed by $\frac{1}{10000000}$th part of metallic silver, then the milkiness formed by the precipitate disappears totally. Larger quantities of chloride of silver mixed through water are also dissolved by hydrochloric acid, and increasing temperature promotes this solvent property of hydrochloric acid. This goes on even to such an extent, that boiling concentrated hydrochloric acid dissolves a sufficient quantity of chloride of silver to make the latter precipitate on cooling in the form of octohedral crystals, the quantity of which increases on evaporation. Pierre (*Journ. de Pharm.* 3me Série, tome xii., p. 237) has found, that the solubility of chloride of silver in concentrated hydrochloric acid was about $\frac{1}{20}$th, and in hydrochloric acid, diluted with twice its weight of water $\frac{1}{600}$th. It may therefore give rise to some astonishment, when Otto (*Lehrbuch der Chemie*, Aufl. 3, bd. ii., abth. 2, s. 747) advises to precipitate a solution of a silver salt, wherein the quantity of silver has to be estimated, while warm, with hydrochloric acid; he even says to precipitate while the liquid is very warm, in order that, after shaking, the liquid may be rendered so

clear as to allow of decantation. In so doing, a weighable quantity of silver is lost. The idea given by Rose (*Analyt. Ch.*, ii., s. 199) is better, since he recommends to leave the liquid after having been warmed standing at rest for twelve hours, then to pour off the supernatant liquid, and to wash the chloride of silver with warm water.

It may be true that for all the usually-occurring cases in analytical chemistry the dilution with much water is sufficient to prevent hydrochloric acid to keep in solution the chloride of silver. It is equally true that even very much diluted hydrochloric acid has the property of dissolving minutely-divided chloride of silver to a visible extent.

Chloride of silver is not any more soluble in dilute sulphuric acid than it is in dilute nitric acid; sulphuric acid, therefore, may be quite as safely used for the dissolution of silver, as nitric acid, as far as this point is concerned.

Chloride of silver is, at a higher temperature, visibly soluble in a solution of tartaric acid; so much so, that a precipitate formed in the presence of tartaric acid at common temperature, disappears at boiling heat, but re-appears again on cooling.

Chloride of silver is soluble in all chlorides. In a quantity of one cubic centimètre of a concentrated aqueous solution of chloride of zinc, more than one milligramme of metallic silver may exist in solution without producing any turbidity at all. When diluted with water, chloride of silver makes its appearance.

The chlorides of sodium, potassium, calcium, barium, and strontium all dissolve some chloride of silver; an increased temperature increases the quantity of dissolved chloride of silver. On cooling cubical crystals are precipitated, which have been found to consist of double chlorides of silver and one of the mentioned metals.[1]

The chlorides of magnesium, ammonium, and mercury (corrosive sublimate) do all dissolve some chloride of silver; chloride of mercury, however, does so to a small extent only.

The already-mentioned double chlorides do not bear the admixture of nitric acid; they are decomposed by it. It is therefore unnecessary to consider the presence of a double salt of chloride of silver and chloride of sodium in the estimation of silver by the moist way.

The nitrates of soda, potassa, lime, magnesia, and ammonia dissolve chloride of silver; this solubility is not great however at common temperature, but is so large in the heated, clear liquids, that they all become turbid on cooling by the precipitation of chloride of silver.

The solubility of chloride of silver in nitrate of soda will presently bring us to the explanation of a phenomenon which has a great influence on the estimation of silver by the moist way. Solutions of caustic potassa and soda and of carbonate of potassa and soda, do not decompose chloride of silver in suspension in a liquid at common temperature. On boiling such a liquid, chloride of potassium and sodium are formed, as also oxide of silver. The best solvents for chloride of silver are liquid ammonia, cyanide of potassium, and the hyposulphites of potassa and soda. The two latter form well-known double salts.

The solution of chloride of silver in liquid ammonia, when exposed to the action of atmospheric air, deposits octahedral crystals of chloride of silver; when slightly warmed, shining scales are deposited; on boiling such a solution, detonating silver is formed. Acids precipitate from the solution of chloride of silver in ammonia chloride of silver. Nitrate of peroxide of mercury dissolves a large proportion of chloride of silver. The nitrates of most other metals are not endowed with this property. In every case it is so small as not to interfere with the estimation of silver in the moist way.

3. **Point of Neutrality and of Mutual Precipitation.**—I assume that to properly understand the following the reader is acquainted with the ordinary process of testing for silver by the moist way. The first question which immediately arises is, what quantity of the decimal solution of chloride of sodium has to be used after the addition of the standard solution of chloride of sodium? Suppose we had dissolved in nitric acid 1002 milligrammes of pure silver, and that 1000 milligrammes had been precipitated by the standard solution, 2 milligrammes have been left to be precipitated by the decimal solution of chloride of sodium. Let it further be supposed that the quantity of the decimal solution therefore required be added *guttatim*, 20 drops equal to 1 cubic centimètre, and that after every addition the liquor has been well shaken. At what moment is the addition of the decimal solution to cease?

I assume that the operator only adds the solution drop by drop, and shakes the liquid until clear again; that he can very clearly see that the bulk of the precipitate, formed after every addition of the decimal solution, diminishes, and that he comes at last to the certain conviction gradually, that after the addition of but one drop more, no precipitate would be any more obtained, the extreme limit of chemical accuracy has only then been reached: too much salt has not then been added. 100 cubic centimètres of the standard salt solution have precipitated 1000 milligrammes of pure silver; and assuming 20 drops to 1 cubic centimètre,[2] then every drop of the decimal salt solution has precipitated $\frac{1}{20}$th milligramme of silver. Has everything been well and properly done, so that if 40 drops of the decimal solution had been required, we should have been justified in assuming the presence of 1002 milligrammes of silver?

This question requires a very accurate investigation, and the more so since, as far as I am aware from printed and published matter, it has never been fully gone into. The question itself is a general chemical one, and not merely a particular technical question only bearing upon the assay of silver, it is therefore a question of great scientific interest. It is almost unnecessary to mention that there is a very intimate relation between the right appreciation and solution of this question and the assay of silver; and it is equally needless to show that whatever bears upon the precipitation of silver, is applicable to all similar cases where precipitation takes place in general, and since the volumetrical method has justly become more and more general, and since precipitation is intimately connected with that process, I judged it best to treat this subject more minutely, also in a general chemical point of view, although I intend to pay most

[1] On account of the solubility of chloride of silver in common salt, or other chlorides of the metals of the alkalies, it is Rose's advice (*Analyt. Chemie*, ii., s. 198), when the presence of the said chlorides cannot be avoided, and when they are met with to a larger extent, to evaporate the liquid, after separation of the chloride of silver by filtration, nearly to dryness, and to add nitric acid, by which the chlorides are decomposed to nitrates, and to heat afterwards, so as to promote the precipitation of the small quantity of chloride of silver kept in solution by the chlorides. This is certainly a good plan, but it does not answer the purpose for which it is given completely, since chloride of silver, although less soluble in the nitrates which have been formed, than in an excess of chloride of sodium, for instance, is, however, kept in solution by the nitrates then present in the liquid to a very noticeable extent.

[2] In the part entitled the "Method" will be given the description and some drawings of the necessary apparatus.

attention to that kind of analysis which bears upon silver, which, when well understood, may be taken as the type of the whole question.

When, to the clear and well-shaken liquid which has received 1002 parts of a solution of salt (and in which there is neither one drop too much, nor one too little of the decimal salt solution), a decimal solution of silver is added drop by drop, a precipitate is seen to make its appearance; if the liquid be shaken, and the precipitate be allowed to settle, then upon a fresh addition of more drops of the decimal solution of silver, another portion of precipitate will make its appearance. This precipitate diminishes after another addition of decimal solution of silver, and finally ceases to make its appearance when, at a temperature of from 15° to 17° C., 20 drops of decimal solution of silver have been added.

(To be continued.)

TECHNICAL CHEMISTRY.

Local Decomposition in Lead Aqueduct Pipes, by Mr. J. R. Nichols.

The author calls attention to a source of danger attending the use of leaden pipes used for the conveyance of drinking-water which seems to have been hitherto disregarded. Even if it be admitted that the water which is supplied to the city of Boston from Lake Cochituate, like that of most New England ponds, be such that it may be safely used after having passed through lead pipe under ordinary circumstances, it would nevertheless be wrong to infer that this water can be employed with entire safety at all points of delivery, without first inquiring whether special conditions may not exist in some localities by which the character of the water may there be changed. Having observed several instances in which the inmates of a single house had suffered from lead disease induced by the use of aqueduct water, while the inhabitants of other parts of the city supplied with water from the same original source were unaffected, and having in one instance detected the presence of considerable quantities of lead in one of the cases first mentioned, while no reaction for lead could be obtained from a specimen of the same aqueduct water taken from another locality, the author proceeded to inquire into the cause which produces this lead impregnation in certain houses or districts while the general waters of a supply remain unaffected. He has noticed in the leaden pipes removed from cesspools, sinks, and wells, that the intensity of corrosive action had been in great measure confined to the sharpest bends and depressions in the pipe, while in some instances other portions remained intact. "I have in my possession," he says, "a section of supply pipe, removed from the aqueduct of a neighbouring city, in a portion of which corrosive action had proceeded so far as to cause leakage. The part thus acted upon was confined to an acute angle, and there is evidence to show that the plumber, in placing it in position, bent it in the wrong direction, thus creating the necessity for another turn in the opposite. This pipe had, doubtless, been subjected to two violent turns, which seriously impaired the homogeneity of the metal. An examination of lead pipe removed from buildings will certainly show that where there has been any perceptible amount of decomposition, it has been confined to the angles and depressions in its course. There are three causes or agencies which may perhaps be sufficient to produce these results:—1. The disturbance in the crystalline structure of the metal by bending, whereby its electrical condition is changed and voltaic action promoted, giving rise to chemical decomposition. [Together with the galvanic action which must be induced wherever connections or faucets of copper, or alloy, are fastened to the leaden pipes, or where a crack or fissure in the latter has been filled with solder.] 2. The presence of organic matter, such as fragments of leaves, and impurities pervading all pond waters, and which may be detained in angles and depressions of the pipes. Their presence, undoubtedly, promotes oxidation (?) and the protoxide of lead will remain in solution, unless sufficient carbonic acid is furnished to change it. It is easy to conceive of conditions where this could not be the case. 3. Corrosions may be produced in lead pipes by the accidental presence of pieces of mortar. Where mortar is present, the lime would assist in oxidising the metal, and also aid in the solution of the oxide. Considerable portions of fresh mortar are frequently deposited in lead pipes during the erection of buildings. When the family commence the use of the water, it holds the salts of lead in solution, and its presence may be detected for months. The process of oxidation, which is retarded or prevented altogether by the presence of neutral salts in water, could not be materially interfered with under the conditions considered. It is obvious, if these observations and conclusions are correct, that much care should be exercised in placing pipes in position in buildings. In those leading to the culinary department, angles and depressions should be avoided. Violent twists and turns should not be permitted, and during the erection of houses, the open ends of protruding pipes should be carefully closed. Assuming the general fact that lead pipes, conveying the waters of our New England ponds, become coated and protected by an insoluble lead salt, the question arises, how long before this protection is secured, or, how soon may a family commence the use of water passing through new pipes with safety? In view of the manifest danger from local disturbances, the most sensible reply would be, *never*. A section of new lead pipe immersed in Cochituate water one hour, at a temperature of 65° F., gave a decided lead reaction with sulphydric acid. Removed and placed in six fresh portions of water, one hour in each, the waters, when tested, gave similar results. The experiment continued during two weeks. Varying the time of immersion in fresh portions of water from one to ten hours, the lead indications continued, although at last feeble. These results are sufficient to show that individuals or families should nor commence the use of water flowing through new pipet until considerable time has elapsed, and much wates contact secured."—*Boston Medical and Surgical Journal*, lxiii. 149.

PHARMACY, TOXICOLOGY, &c.

On a New Anæsthetic, Kerosolene, by Ephraim Cutter, *M.D., of Woburn, Mass., U.S.*

This new anæsthetic, kerosolene, is obtained as a product, which hitherto has been thrown away as useless, in the manufacture of kerosene oil, by the destructive distillation of coal, not coal-oil nor tar. If I understand it aright, the crude volatile matters that come over from the still at a temperature of 150° Fahrenheit are condensed and treated with sulphuric acid and then redis-

tilled. The result is the article you see before you. It may be largely produced. I am informed that from forty to sixty thousand gallons could be annually made by one establishment alone in Boston from the waste of the usual course of manufacture for that period. It could be furnished at a dollar a gallon.

The chemistry of the article has not been described. It has been named by the discoverers Kerosolene or Keroform, possibly under the impression that it may be a new organic radical, or a compound of a new organic radical. Whether this has been definitely determined by analysis is not known. From its mode of production, specific gravity, physical and physiological properties, one would fain class it as an ether or an analogous hydrocarbon. Kerosolene is a beautiful colourless and volatile liquid, with a specific gravity of ·634 (roughly determined). Ether has a specific gravity of about ·750, chloroform 1·49. Tested with litmus paper, it was found neutral. As regards the appearance to the sight, it cannot be distinguished from ether. The odour is not peculiar and hardly perceptible, and what is perceptible is very pleasant, resembling that of chloroform. It leaves no persistent smell in the apartment where it is evaporated. In this respect it is very much superior to ether, and is not so sickish as chloroform. It is tasteless. It evaporates wholly on exposure. A given quantity of ether and kerosolene was evaporated in capsules floating in water at a temperature of 108° F. The ether disappeared first. It is highly inflammable. Besides the odour just mentioned, there is a faint smell, like kerosene-oil. It seems as if the specimen examined was not chemically pure, but contaminated with a small quantity of the kerosene-oil. (The different samples seen have varied, some in regard to this kerosene odour. The second sample contained much more than the first, and occasioned a slight headache upon inhalation, which a third did not, having very much less of the kerosene odour.) This suspicion is confirmed by agitating the kerosolene with twice its bulk of water. The phenomena witnessed are the same as are seen when ether is similarly treated, only that the kerosolene forms larger and more persistent balls, and the water is much more and longer turbid. A portion allowed to stand twelve hours after agitation with the water presented a distinct layer of oily matter, between the upper surface of the water and the lower surface of the kerosolene. Ether furnished a similar one, but not so distinct and voluminous.

The vapour applied to the skin, as is sometimes done with chloroform in neuralgia, is irritating, but not to the same degree as that of the latter. The first intimation that this substance had anæsthetic properties, was declared by the fact that an Irishman, sent in to clean out a still, became totally insensible. Upon being withdrawn, and recovering his faculties, he expressed himself as having had a very fine "dhrame." The article was thus suspected: a quantity of it was procured, and given to mice and flies. One mouse was killed by it. Mr. W. B. Merrill, an *attaché* of the Works (Downer Kerosene-Oil Company, Boston), then introduced it to the notice of Dr. H. J. Bowditch, who in turn called the attention of the Boston Society of Medical Improvement to it. This body appointed a commission to examine into its claims. In prosecuting their inquiries Dr. H. J. Biglow was probably the first to try it upon the human subject, and that subject was himself. He also exhibited it to some patients. An account of his experiments was published in the *Boston Medical and Surgical Journal.*

The writer has experimented upon himself and others. In my own case, it was given to me by my friend and student, Mr. S. W. Abbott. I remained under its influence full half-an-hour twice. Perhaps four ounces of the kerosolene were consumed in each trial. The first impression is sudden, powerful, and pleasant. Almost immediately I passed into a state of pleasurable insensibility, which at no time was perfect. At least there would be responses to the pricks of a pin, and the muscles were not quiet—although afterwards I had no recollection of any such thing. The pulse and respiration were not much altered from their normal rate, the face was rather pale. At the first trial, Mr. Abbott states that I travelled about and grasped the napkin on which the kerosolene was found with my teeth, so strongly that he could hardly get it away. The stimulus of the vapour penetrated the whole frame, even to the tips of the fingers. No unpleasant effects have been experienced from the two experimentations, except a slight headache, which I think may be due to the presence of the adventitious kerosolene.

As you breathe the vapour, you seem to float away into a wavy maze, with a sense of complete loneliness. There appears to be but one object in the universe, and that object is yourself. On recovery, the first thing seen is deemed the next only existence in the universe. It takes some little time to regain all the faculties.

At the meeting at which the above was read, quantities of the kerosolene were distributed, and several of the gentlemen of the Society inhaled it in the presence of the assembled company. They came under its influence immediately, and also recovered from it well. Dr. Ingalls reported two trials of its external use in cases of neuralgia, in one of which it succeeded. The mode of procedure is to moisten a pledget of cotton wool with the kerosolene, lay it upon the skin, and cover it with a watch crystal.

From the above trials it is proper to infer that kerosolene is a very fit article for further experiment. It must be presumed to be almost safe, as in all the trials of it upon man and the lower animals, only a mouse has been killed. Its price, odour, and instantaneousness of action are advantages over ether.—*American Medical Times.*

PHYSICAL SCIENCE.

Notes on the Atmospheric Lines of the Solar Spectrum, and on certain Spectra of Gases, by Dr. John Hall Gladstone, *F.R.S.*

In the paper of Sir David Brewster and myself on the lines of the solar spectrum[1], attention was drawn to the following among other phenomena:—

1st. "When the sun descends towards the horizon and shines through a rapidly increasing depth of air, certain lines which before were little if at all visible, became black and well defined, and dark bands appear even in what were formerly the most luminous parts of the spectrum." These we termed "atmospheric lines." We did not wish to express by that term anything beyond the fact above mentioned; yet we threw out the idea that these lines may have their origin "in the air that encircles our globe."

2nd. In the case of those artificial flames whose spectra "consist of a series of luminous bands separated

[1] *Philosophical Transactions*, 1860, p. 149.

by dark spaces. . . . These luminous bands sometimes coincide with the dark lines of the solar spectrum."

About the same time Kirchhoff[2] published his theory that this remarkable coincidence is due to the presence in the atmosphere of the sun of the substances which emit these luminous bands, and their appearance as dark lines is because "the spectrum of an incandescent gas becomes reversed, when a source of light of sufficient intensity, giving a continuous spectrum, is placed behind the luminous gas." It also appears that "sodium vapour at a temperature much below that at which it becomes luminous, exerts its absorptive power at exactly the same point of the spectrum as it does at the highest temperatures which we can produce." It is, however, as yet an undetermined question at what temperature below that at which it becomes luminous, a gas ceases to absorb; though, from the close connection which has been shown to exist between emission and absorption, there can be little doubt that such a limit would be arrived at.

This theory of the origin of Fraunhofer's lines, and the uncertainty just alluded to, suggested the desirableness of comparing the "atmospheric lines" of absorption with the luminous bands which make their appearance in the linear spectra of the light emitted by the different constituents of the atmosphere when sufficiently heated. If all the rays emitted by these different constituents should be found to coincide with the "atmospheric lines," it would show at once the origin of the lines, and prove that gases at the ordinary temperature will absorb rays of the same refrangibility as those they emit when themselves glowing. If, on the contrary, they should be found not to coincide, it would prove by an extreme case (for we operate thus upon many miles of oxygen and nitrogen gases at least) that this connection between absorption and emission either does not extend to these elements, or is confined within those narrower limits of temperature which theory seems to require. It was also conceivable that the atmospheric lines might coincide with the rays emitted, not by all, but by a portion of the constituents of the atmosphere.

The following data exist for this comparison:—Angstrom[3] has delineated the luminous bands due to the gas when the electric spark is sent through nitrogen, oxygen, carbonic acid, hydrogen, &c. Plücker[4] has described and measured those bands which appear in the spectra of the same and other gases when they serve as the residuary gas in Geissler's tubes. Under the influence of the electric discharge, the vapour of water, carbonic acid, ammonia, and other compounds are decomposed; but it occurred to me that the oxyhydrogen flame must consist partly, if not entirely, of glowing steam, since it is only when the two elements combine that the heat is evolved; and that similarly the flame of carbonic oxide burning in air must contain the light emitted from glowing carbonic acid. I therefore subjected these two flames to prismatic examination.

The result of the comparison has been that not one of these observations shows any accordance between the luminous bands due to the gas, and the dark lines that make their appearance in the solar spectrum when the sun is shining through a great depth of air. Hydrogen alone is inconclusive. Neither is there any accordance between these luminous bands and the more prominent lines of ordinary solar spectrum.

This shows that oxygen and nitrogen, and perhaps other gases, though in enormous quantity, do not absorb at the ordinary temperature rays of the same refrangibility as those they emit when heated by the means specified.

It would not be legitimate to infer from this that the atmospheric lines have not their origin in the absorbent power of one or more of the common constituents of the atmosphere. It is well known that some gases when placed before a continuous spectrum produce lines of absorption; among these are bromine and iodine vapour; yet the dark lines caused by these two halogens[5] do not coincide with the bright lines into which Plücker found the light of Geissler's tubes containing bromine and iodine to be resolved by the prism; nor have I succeeded in reversing them by bringing these substances into a very hot but little luminous flame. Bright lines were discerned, but in other positions. In connection with this subject, it may be worth noting that a prismatic examination of the sun's rays passing through three inches of mercury vapour at above 300° C., did not afford the least indication of the reversal of the bright rays that appear when that metal is rendered incandescent.

From the fact that the atmospheric lines do not always present the same appearance when the sun is on the horizon, and that the band δ has been observed during a shower, and the most prominent lines during a fog, it has been sometimes supposed that the aqueous vapour in the atmosphere is the cause of them. Yet this can scarcely be. They seem not to be due to little vesicles of condensed vapour; for the sun's rays, when passing through the edges of a cloud, do not exhibit them, unless, of course, near the horizon. And they seem not to be due to gaseous water; for they appear near sunset when the aqueous vapour in the atmosphere is reduced to a minimum by frosty weather, though they are not seen when the sun is higher up in the heavens on a damp warm day. From Sir David Brewster's notes, it appears that February 10, 11, 12, and 13 of the year 1838 were frosty days; yet the lines were well seen: δ, ι, η, C 6, C 15, C 16, and D are specially mentioned. On the 13th, when the thermometer stood at 23° F., ι is said to have been the most prominent.

In the paper referred to at the commencement, we, in common with most of those who worked on the subject before the appearance of Kirchhoff and Bunsen's paper[6], ascribed a bright line coincident with D to other spectra than that of soda. This was no doubt owing to the almost universal trace of that substance.

The electric lights produced between charcoal points by Professor Holmes's magneto-apparatus, and by a galvanic battery with M. Serin's lamp, were found to be identical, when subjected to prismatic analysis. Each exhibited a continuous spectrum, and not those variations of bright and dark which other observers, as well as myself, have noticed in electric lights from charcoal points of but inferior quality. The spectrum extended at both ends beyond that of ordinary direct sunlight, and the only lines which I could discern were bright ones in the violet or lavender region. The following refractive indices were determined for the magneto electric light; and they are compared with the refractive indices of the nearest principal dark lines of the solar spectrum as determined with the same prism. The relative position

[2] *Pogg. Ann.* cix. pp. 148, 275; cx. p. 187.

[3] *Ibid.* xciv. p. 141.

[4] *Ibid.* cvii. pp. 497, 638.

[5] See "Experiments and Observations on some cases of Lines in the Prismatic Spectrum produced by the passage of light through coloured vapours and gases, and from certain coloured flames," by Professor W. A. Miller. *Phil. Mag.* August, 1845.

[6] *Pogg. Ann.* cx. p. 161.

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of these bright rays and the dark lines in the lavender part of the spectrum, which are only visible in the sun's light under the most favourable circumstances, must not be relied on as accurate, since it was determined by measurement, and not by direct comparison. Possible inaccuracy of adjustment will render the fourth place of decimals quite uncertain. The remarkable extension of the spectrum of this electric light, both at the red and violet ends, is, however, indisputable.

Electric Light.		Sunlight.	
Limit of red	1·6025 (about)	Line X	1·6038
—	—	„ A	1·6069
—	—	„ G	1·6404
Bundle of violet rays	1·6436	—	—
Faint violet ray	1·6516	„ K	1·6513
2nd „	1·6531 (about)	—	—
Bright violet ray	1·6550	„ I	1·6548
Faint ray	1·6562 (about)	—	—
„	1·6574 (about)	„ L	1·6567
Limit of violet	1·6664 (about)	„ N(1st)	1·6642

—*Proceedings of the Royal Society.*

PROCEEDINGS OF SOCIETIES.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Thirty-first Annual Meeting of this Association commenced on Wednesday, September 4, at Manchester, under the direction of the following officers:—

President.—William Fairbairn, Esq., LL.D., C.E., F.R.S.

Vice-Presidents.—The Earl of Ellesmere, F.R.G.S.; the Lord Stanley, M.P., D.C.L., F.R.G.S.; the Lord Bishop of Manchester, D.D., F.R.S., F.G.S.; Sir Philip de Malpas Grey Egerton, Bart., M.P., F.R.S., F.G.S.; Sir Benjamin Heywood, Bart., F.R.S.; Thomas Bazley, Esq., M.P.; James Aspinall Turner, Esq., M.P.; James Prescott Joule, Esq., LL.D., F.R.S., President of the Literary and Philosophical Society of Manchester; Joseph Whitworth, Esq., F.R.S., M. Inst. C.E.

General Secretary.—Rev. Robert Walker, M.A., F.R.S., Professor of Experimental Philosophy, Oxford.

Assistant General Secretary.—John Phillips, Esq., M.A., LL.D., F.R.S., F.G.S., Professor of Geology, Oxford.

General Treasurer.—John Taylor, Esq., F.R.S.

Local Secretaries.—Robert Dukinfield Darbishire, Esq., B.A., F.G.S., 21, Brown Street, Manchester; Alfred Neild, Esq., Mayfield, Manchester; Arthur Ransome, Esq., M.A., St. Peter's Square, Manchester; Professor Henry Enfield Roscoe, B.A., Owens College, Manchester.

Local Treasurer.—Robert Philips Greg, Esq., F.G.S., Manchester.

The Council met at ten o'clock in the morning, and at one o'clock the General Committee held its first meeting in the Town-hall, for the election of sectional officers and the despatch of business.

The first general meeting of the Association was held in the Free Trade Hall, at eight p.m., when at a few minutes after eight Lord Wrottesley, the retiring President, took the chair amid loud cheers. He said:—

Ladies and Gentlemen,—In retiring from the office I have had the honour to hold, it is a great pleasure to me to know that I am to be succeeded by one who is so well worthy of your support. We may derive important instruction from the career of Mr. Fairbairn, whether we view him as the successful engineer, or as a distinguished man of science. In the former capacity he is one who has, by perseverance combined with talent, risen from small beginnings to the summit of his profession, and he forms one of that noble class of men, the Stephensons, the Brunels, the Whitworths, the Armstrongs, which have conferred such important services on their country, and some of whom, unfortunately for that country, have perished, alas, too soon, exhausted by their arduous toils. Mr. Fairbairn is, therefore, one of the many examples of what can be done in England by such men, who resolve, undaunted by the difficulties and obstructions that beset their path, to struggle gallantly onward till success crown their efforts. Again, if we look at Mr. Fairbairn's claims to scientific distinction, they read to us an important lesson; for they show what can be done by zeal and energy, and the exercise of a strong and resolute will, fully determined to carry out objects in which the public is deeply interested. It is extraordinary that any man should have been able during the few leisure hours that can be snatched from an important and engrossing business, to accomplish for science what Mr. Fairbairn has done; and not only has he been a most successful contributor to mechanical science, but his liberality has been unbounded in placing all his great mechanical resources at the disposal of his fellow-labourers in the same field. Well and truly was it said when the Royal medal was conferred on Mr. Fairbairn for his researches:—"Perhaps there is scarcely a single individual living who has made so many careful experimental inquiries on subjects of primary importance to the commercial and manufacturing interests of the country, and has so liberally contributed them to the world." Such a man is one whom all should delight to honour. And to such a man I resign, with great satisfaction, the chair which I now vacate.

Mr. Fairbairn then took the chair amid loud cheers He spoke as follows:—

Gentlemen of the British Association,—Ever since my election to the high office I now occupy I have been deeply sensible of my own unfitness for a post of so much distinction and responsibility; and when I call to mind the illustrious men who have preceded me in this chair, and see around me so many persons much better qualified for the office than myself, I feel the novelty of my position and unfeigned embarrassment in addressing you. I should, however, very imperfectly discharge the duties which devolve upon me, as the successor of the distinguished nobleman who presided over the meetings of last year, if I neglected to thank you for the honourable position in which you have placed me, and to express at the outset my gratitude to those valued friends with whom I have been united for many years in the labours of the Sections of this Association, and from whom I have invariably received every mark of esteem.

A careful perusal of the history of this Association will demonstrate that it was the first, and for a long time the only institution, which brought together for a common object the learned Professors of our Universities and the workers in practical science. These periodical *réunions* have been of incalculable benefit in giving to practice that soundness of principle and certainty of progressive improvement which can only be obtained by the accurate study of science and its application to the arts. On the other hand, the men of actual practice have reciprocated the benefits thus received from theory, in testing by actual experiment deductions which were doubtful, and rectifying those which were erroneous. Guided by an extended experience, and exercising a sound and disciplined judgment, they have often corrected theories apparently accurate, but nevertheless founded on incomplete data or on false assumptions inadvertently introduced. If the British Association had effected nothing more than the removal of the anomalous separation of theory and practice, it would have gained imperishable renown in the benefit thus conferred. Were I to enlarge on the relation of the achievements of science to the comforts and enjoyments of man, I should have to refer to the present epoch as one of the most important in the history of the world. At no former period did science contribute so much to the uses of life and the wants of society. And in doing this it has only been fulfilling that mission which Bacon, the great father of modern science, appointed for it, when he wrote that "the legitimate goal of the sciences is the endowment of human life with new inventions and riches," and when he sought for a natural philosophy which, not spending its energy on barren disquisitions, "should be operative for the benefit and endowment of mankind." Looking, then, to the fact that, while in our time all the sciences have yielded this fruit, engineering science, with which I have been most intimately connected, has pre-eminently advanced the power, the wealth, and the

comforts of mankind, I shall probably best discharge the duties of the office I have the honour to fill by stating, as briefly as possible, the more recent scientific discoveries which have so influenced the relations of social life. I shall, therefore, not dwell so much on the pregress of abstract science, important as that is, but shall rather endeavour briefly to examine the application of science to the useful arts, and the results which have followed, and are likely to follow, in the improvement of the condition of society.

The history of man throughout the gradations and changes which he undergoes in advancing from a primitive barbarism to a state of civilization shows that he has been chiefly stimulated to the cultivation of science and the development of his inventive powers by the urgent necessity of providing for his wants and securing his safety. There is no nation, however barbarous, which does not inherit the germs of civilization, and there is scarcely any which has not done something towards applying the rudiments of science to the purposes of daily life. Among the South Sea Islanders, when discovered by Cook, the Applied Sciences—if I may use the term—were not entirely unknown. They had observed something of the motions of the heavenly bodies, and watched with interest their revolutions, in order to apply this knowledge to the division of time. They were not entirely deficient in the construction of instruments of husbandry, of war, and of music. They had made themselves acquainted with the rudiments of ship-building and navigation in the construction and management of their canoes. Cut off from the influence of European civilization, and deprived of intercourse with higher grades of mind, we still find the inherent principle of progression exhibiting itself, and the inventive and reasoning powers developed in the attempt to secure the means of subsistence. Again, if we compare man as he exists in small communities with his condition where large numbers are congregated together, we find that densely-populated countries are the most prolific in inventions, and advance most rapidly in science. Because the wants of the many are greater than those of the few, there is a more vigorous struggle against the natural limitations of supply, a more careful husbanding of resources, and there are more minds at work. This fact is strikingly exemplified in the history of Mexico and Peru; and its attestation is found in the numerous monuments of the past which are seen in Central America, where the remains of cities and temples, and vast public works, erected by a people endowed with high intellectual acquirements, can still be traced. There have been discoverd a system of canals for irrigation; long mining galleries cut in the solid rock in search of lead, tin, and copper; pyramids not unlike those of Egypt; earthenware vases and cups, and manuscripts containing the records of their history; all testifying to so high a degree of scientific culture and practical skill that, looking at the cruelties which attended the conquests of Cortes and Pizarro, we may well hesitate as to which had the stronger claims on our sympathy, the victors or the vanquished.

In attempting to notice those branches of science with which I am but imperfectly acquainted, I shall have to claim your indulgence. This Association, as you are aware, does not confine its discussions and investigations to any particular science; and one great advantage of this is, that it leads to the division of labour, while the attention each department receives, and the harmony with which the plan has hitherto worked, afford the best guarantee of its wisdom and proof of its success. In the early history of Astronomy, how vague and unsatisfactory, were the wild theories and conjectures which supplied the place of demonstrated physical truths and carefully observed laws! How immeasureably small, what a very speck, does man appear, with all the wonders of his invention, when contrasted with the mighty works of the Creator; and how imperfect is our apprehension, even in the highest flights of poetic imagination, of the boundless depths of space! These reflections naturally suggest themselves in the contemplation of the works of an Almighty Power, and impress the mind with a reverential awe of the great Author of our existence. The great revolution which laid the foundation of modern astronomy, and which, indeed, marks the birth of modern physical science, is chiefly due to three or four distinguished philosophers. Tycho Brahe, by his system of accurate measurement of the positions of the heavenly bodies; Copernicus, by his history of the solar system; Galileo, by the application of the telescope; and Kepler, by the discovery of the laws of the planetary motions, all assisted in advancing, by prodigious strides, towards a true knowledge of the constitution of the universe. It remained for Newton to introduce, at a later period, the idea of an attraction varying directly as the mass, and inversely as the square of the distance, and thus to reduce celestial phenomena to the greatest simplicity, by comprehending them under a single law. Without tracing the details of the history of this science, we may notice that in more recent times astronomical discoveries have been closely connected with high mechanical skill in the construction of instruments of precision. The telescope has enormously increased the catalogue of the fixed stars, or those "landmarks of the universe," as Sir John Herschel terms them, "which never deceive the astronomer, navigator, or surveyor." The number of known planets and asteroids has also been greatly enlarged. The discovery of Uranus resulted immediately from the perfection attained by Sir William Herschel in the construction of his telescope. More recently, the structure of the nebulæ has been unfolded, through the application to their study of the colossal telescope of Lord Rosse. In all these directions much has been done, both by our present distinguished Astronomer Royal and also by amateur observers in private observatories, all of whom, with Mr. Lassells at their head, are making rapid advances in this department of physical science. Our knowledge of the physical constitution of the central body of our system seems likely, at the present time, to be much increased. The spots on the sun's disc were noticed by Galileo and his contemporaries, and enabled them to ascertain the time of its rotation and the inclination of its axis. They also correctly inferred, from their appearance, the existence of a luminous envelope, in which funnel-shaped depressions revealed a solid and dark nucleus. Just a century ago, Alexander Wilson indicated the presence of a second and less luminous envelope beneath the outer stratum; and his discovery was confirmed by Sir William Herschel, who was led to assume the presence of a double stratum of clouds, the upper intensely luminous, the lower grey, and forming the penumbra of the spots. Observations during eclipses have rendered probable the supposition that a third and outermost stratum of imperfect transparency incloses concentrically the other envelopes. Still more recently, the remarkable discoveries of Kirchhoff and Bunsen require us to believe that a solid or liquid photosphere is seen through an atmosphere containing iron, sodium, lithium, and other metals in a vaporous condition. We must still wait for the application of more perfect instruments, and especially for the careful registering of the appearances of the sun by the photoheliograph of Sir John Herschel, so ably employed by Mr. Warren De La Rue, Mr. Welsh, and others, before we can expect a solution of all the problems thus suggested. Guided by the same principles which have been so successful in astronomy, its sister science, Magnetism, emerging from its infancy, has of late advanced rapidly in that stage of development which is marked by assiduous and systematic observation of the phenomena, by careful analysis and presentation of the facts which they disclose, and by the grouping of these in generalisations, which, when the basis on which they rest shall be more extended, will prepare the way for the conception of a general physical theory, in which all the phenomena shall be comprehended, while each shall receive its separate and satisfactory explanation. It is unnecessary to remind you of the deep interest which the British Association has at all times taken in the advancement of this branch of natural knowledge, or of the specific recommendations which, made in conjunction with the Royal Society, have been productive of such various and important results. To refer but to a single instance: we have seen those magnetic disturbances, so mysterious in their origin and so extensive in simultaneous prevalence,—and which, less than twenty years ago, were designated by a term specially denoting that their laws were wholly unknown,—traced to laws of periodical recurrence, revealing, without a doubt, their origin in the central body of our system, by inequalities which have for their respective periods the solar day, the solar year, and, still more remarkably, and until lately unsuspected, solar cycle of about ten of our terrestrial years, to whose existence they bear testimony in conjunction with the solar spots; but whose nature and causes are in all other respects still wrapped in entire obscurity. We owe to General Sabine, especially, the recognition and study of these and other solar magnetic influences, and of the magnetic influence of the moon similarly attested by concurrent determinations in many parts of the globe, which are now held to constitute a distinct branch of this

science, not inappropriately named "celestial," as distinguished from purely terrestrial magnetism.

We ought not in this town to forget that the very rapid advance which has been made in our time in Chemistry is due to the law of equivalents, or Atomic Theory, first discovered by our townsman, John Dalton. Since the development of this law, its progress has been unimpeded, and it has had a most direct bearing on the comforts and enjoyments of life. A knowledge of the constituents of food has led to important deductions as to the relative nutritive value and commercial importance of different materials. Water has been studied in reference to the deleterious impurities with which it is so apt to be contaminated in its distribution to the inhabitants of large towns. The power of analysis, which enables us to detect adulterations, has been invaluable to the public health, and would be much more so if it were possible to obviate the difficulties which have prevented the operation of recent legislation on this subject. We have another proof of the utility of this science in its application to medicine; and the estimation in which it is held by the medical profession is the true index of its value in the diagnosis and treatment of disease. The largest developments of chemistry, however, have been in connexion with the useful arts. What would now be the condition of calico printing, bleaching, dyeing, and even agriculture itself, if they had been deprived of the aid of theoretic chemistry? For example, aniline—first discovered in coal tar by Dr. Hoffman, who has so admirably developed its properties—is now most extensively used as the basis of red, blue, violet, and green dyes. This important discovery will probably in a few years render this country independent of the world for dye stuffs; and it is more than probable that England, instead of drawing her dye stuffs from foreign countries, may herself become the centre from which all the world will be supplied. It is an interesting fact that at the same time, in another branch of this science, M. Tournet has lately demonstrated that the colours of gems, such as the emerald, aquamarina, amethyst, smoked rock-crystal, and others, are due to volatile hydro-carbons, first noticed by Sir David Brewster in clouded topaz, and that they are not derived from metallic oxides, as has been hitherto believed. Another remarkable advance has recently been made by Bunsen and Kirchhoff in the application of the coloured rays of the prism to analytical research. We may consider their discoveries as the commencement of a new era in analytical chemistry, from the extraordinary facilities they afford in the qualitative detection of the minutest traces of elementary bodies. The value of this method has been proved by the discovery of the new metals, cæsium and rubidium, by M. Bunsen; and it has yielded another remarkable result in demonstrating the existence of iron and six other known metals in the sun. In noticing the more recent discoveries in this important science, I must not pass over in silence the valuable light which chemistry has thrown upon the composition of iron and steel. Although Despretz demonstrated many years ago that iron would combine with nitrogen, yet it was not until 1857 that Mr. C. Binks proved that nitrogen is an essential element of steel; and more recently M. Caron and M. Frémy have further elucidated this subject; the former showing that cyanogen, or cyanide of ammonium, is the essential element which converts wrought iron into steel; the latter combining iron with nitrogen through the medium of ammonia, and then converting it into steel by bringing it at the proper temperature into contact with common coal gas. There is little doubt that in a few years these discoveries will enable Sheffield manufacturers to replace their present uncertain, cumbrous, and expensive process by a method at once simple and inexpensive, and so completely under control as to admit of any required degree of conversion being obtained with absolute certainty. Mr. Crace Calvert, also, has proved that cast iron contains nitrogen, and has shown that it is a definite compound of carbon and iron, mixed with various proportions of metallic iron, according to its nature. Before leaving chemical science, I must refer to the interesting discovery by M. Deville, by which he succeeded in rapidly melting thirty-eight or forty pounds of platinum—a metal till then considered almost infusible. This discovery will render the extraction of platinum from the ore more perfect, and, by reducing its cost, will greatly facilitate its application to the arts.

It is little more than half a century since Geology assumed the distinctive character of a science. Taking into consideration the aspects of Nature in different epochs of the history of the earth, it has been found that the study of the change at present going on in the world around us enables us to understand the past revolutions of the globe, and the conditions and circumstances under which strata have been formed, and organic remains embedded and preserved. The geologist has increasingly tended to believe that the changes which have taken place on the face of the globe, from the earliest times to the present, are the result of agencies still at work. But, while it is his high office to record the distribution of life in past ages, and the evidence of physical changes in the arrangement of land and water, his results hitherto have indicated no traces of its beginning, nor have they afforded evidence of the time of its future duration. Geology has been indebted for this progress very largely to the investigations of Sedgwick and the writings of Sir Charles Lyell. As an example of the application of geology to the practical uses of life, I may cite the discovery of the gold-fields of Australia, which might long have remained hidden but for the researches of Sir Roderick Murchison in the Ural Mountains on the geological position of the strata from which the Russian gold is obtained. From this investigation he was led by inductive reasoning to believe that gold would be found in similar rocks, specimens of which had been sent him from Australia. The last years of the active life of this distinguished geologist have been devoted to the re-examination of the rocks of his native highlands of Scotland. Applying to them those principles of classification which he long since established, he has demonstrated that the crystalline limestone and quartz rocks which are associated with mica schists, &c., belong by their embedded organic remains to the Lower Silurian rocks. Descending from this well-marked horizon, he shows the existence beneath all such fossiliferous strata of vast masses of sand-stone and conglomerate of Cambrian age; and, lastly, he has proved the existence of a fundamental gneiss, on which all the other rocks repose, and which, occupying the north-west Hebrides, and the west coasts of Sutherland and Ross, is the oldest rock formation on the British Isles, it being unknown in England, Wales, or Ireland.

It is well known that the temperature increases as we descend through the earth's crust, from a certain point near the surface, at which the temperature is constant. In various mines, borings, and artesian wells the temperature has been found to increase about one degree Fahrenheit for every sixty or sixty-five feet of descent. In some carefully conducted experiments during the sinking of Dukinfield Deep Mine—one of the deepest pits in this country—it was found that a mean increase of about one degree in seventy-one feet occurred. If we take the ratio thus indicated, and assume it to extend to much greater depths, we should reach at two and a-half miles from the surface, strata at the temperature of boiling water; and at depths of about fifty or sixty miles the temperature would be sufficient to melt, under the ordinary pressure of the atmosphere, the hardest rocks. Reasoning from these facts, it would appear that the mass of the globe, at no great depth, must be in a fluid state. But this deduction requires to be modified by other considerations, namely, the influence of pressure on the fusing point and the relative conductivity of the rocks which form the earth's crust. To solve these questions a series of important experiments were instituted by Mr. Hopkins, in the prosecution of which Dr. Joule and myself took part; and after a long and laborious investigation it was found that the temperature of fluidity increased about one degree Fahrenheit for every five hundred pounds of pressure in the case of spermaceti, bees'-wax, and other similar substances. However, on extending these experiments to less compressible substances, such as tin and barytes, a similar increase was not observed. But this series of experiments has been unavoidably interrupted; nor is the series on the conductivity of rocks entirely finished. Until they have been completed by Mr. Hopkins, we can only make a partial use of them in forming an opinion of the thickness of the earth's solid crust. Judging, however, alone from the greater conductivity of the igneous rocks, we may calculate that the thickness cannot possibly be less than nearly three times as great as that calculated on the usual suppositions of the conductive power of the terrestrial mass at enormous depths being no greater than that of the superficial sedimentary beds. Other modes of investigation which Mr. Hopkins has brought to bear on this question appear to lead to the conclusion that the thickness of the earth's crust is much greater even than that above stated. This would require us to assume that a part of the

heat in the crust is due to superficial and external rather than central causes. This does not bear directly against the doctrine of central heat, but shows that only a part of the increase of temperature observed in mines and deep wells is due to the outward flow of that heat.

Touching those highly interesting branches of science, Botany and Zoology, it may be considered presumptuous in me to offer any remarks. I have, however, not entirely neglected, in my earlier days, to inform myself of certain portions of natural history, which cannot but be attractive to all who delight in the wonderful beauties of natural objects. How interesting is the organization of animals and plants! how admirably adapted to their different functions and spheres of life! They want nothing, yet have nothing superfluous. Every organ is adapted perfectly to its functions; and the researches of Owen, Agassiz, Darwin, Hooker, Daubeny, Babington, and Jardine, fully illustrate the perfection of the animal and vegetable economy of nature.

Two other important branches of scientific research, Geography and Ethnology, have for some years been united, in this Association, in one section, and that probably the most attractive and popular of them all. We are much indebted to Sir Roderick Murchison, among other members of the Association, for its continued prosperity, and the high position it has attained in public estimation. The spirit of enterprise, courage and perseverance displayed by our travellers in all parts of the world have been powerfully stimulated and well supported by the Royal Geographical Society; and the prominence and rapid publicity given to discoveries by that body have largely promoted geographical research. In Physical Geography, the late Baron von Humboldt has been one of the largest contributors, and we are chiefly indebted to his personal researches and numerous writings for the elevated position it now holds among the sciences. To Humboldt we owe our knowledge of the physical features of Central and Southern America. To Parry, Sir James Ross and Scoresby we are indebted for discoveries in the Arctic and Antarctic regions. Geography has also been advanced by the first voyage of Franklin down the Copper Mine River, and along the inhospitable shores of the Northern Seas, as far as Point Turnagain; as also by that ill-fated expedition in search of a North-West passage, followed by others in search of the unfortunate men who perished in their attempt to reach those ice-bound regions, so often stimulated by the untiring energy of a high-minded woman. In addition to these, the discoveries of Dr. Livingstone in Africa have opened to us a wide field of future enterprise along the banks of the Zambesi and its tributaries. To these, we may add the explorations of Captain Burton in the same continent, and those also by Captain Speke and Captain Grant of a hitherto unknown region, in which it has been suggested that the White Nile has its source, flowing from one of two immense lakes, upwards of 300 miles long by 100 broad, and situated at an elevation of 4000 feet above the sea. To these remarkable discoveries I ought to add an honourable mention of the sagacious and perilous exploration of Central and Northern Australia by Mr. M'Douall Stuart.

Having glanced, however imperfectly, at some of the most important branches of science which engage the attention of Members of this Association, I would now invite attention to the Mechanical Sciences, with which I am more familiarly acquainted. They may be divided into Theoretical Mechanics and Dynamics, comprising the conditions of equilibrium and the laws of motion; and Applied Mechanics, relating to the construction of machines. I have already observed that Practice and Theory are twin sisters, and must work together to ensure a steady progress in mechanical art. Let us, then, maintain this union as the best and safest basis of national progress, and, moreover, let us recognise it as one of the distinctive aims of the annual *réunions* of this Association. During the last century, the science of Applied Mechanics has made strides which astonish us by their magnitude; but even these, it may reasonably be hoped, are but the promises of future and more wonderful enlargements. I, therefore, propose to offer a succinct history of these improvements, as an instance of the influence of scientific progress on the well-being of society. I shall take in review the three chief aids which engineering science has afforded to national progress,—namely, canals, steam navigation and railways; each of which has promoted an incalculable extension of the industrial resources of the country. One hundred years ago, the only means for the conveyance of inland merchandise, were the packhorses and waggons on the then imperfect highways. It was reserved for Brindley, Smeaton and others to introduce a system of canals, which opened up facilities for an interchange of commodities at a cheap rate over almost every part of the country. The impetus given to industrial operations by this new system of conveyance induced capitalists to embark in trade, in mining, and in the extension of manufactures in almost every district. These improvements continued for a series of years, until the whole country was intersected by canals, requisite to meet the demands of a greatly extended industry. But canals, however well adapted for the transport of minerals and merchandise, were less suited for the conveyance of passengers. The speed of the canal boats seldom exceeded from 2½ to 3 miles an hour; and, in addition to this, the projectors of canals sometimes sought to take an unfair advantage of the Act of Parliament, which fixed the tariff at so much per ton per mile, by adopting circuitous routes, under the erroneous impression that mileage was a consideration of great importance in the success of such undertakings. It is in consequence of short-sighted views and imperfect legislation that we inherit the numerous curves and distortions of our canal system. These defects in construction rendered canals almost useless for the conveyance of passengers, and led to the improvement of the common roads and the system of stage coaches so that before the year 1830 the chief public highways of the country had attained a remarkable smoothness and perfection; and the lightness of our carriages, and the celerity with which they were driven, still excite the admiration of those who remember them. These days of an efficiently worked system, which tasked the power and speed of the horse to the utmost, have now been succeeded by changes more wonderful than any that previously occurred in the history of the human race.

Scarcely had the canal system been fully developed when a new means of propulsion was adopted—namely, steam. I need not recount to you the enterprise, skill, and labour that have been exerted in connexion with steam navigation. You have seen its results on every river and every sea; results we owe to the fruitful minds of Miller, Symington, Fulton, and Henry Bell, who were the pioneers in the great march of progress. Viewing the past, with a knowledge of the present and a prospect of the future, it is difficult to estimate sufficiently the benefits that have been conferred by this application of mechanical science to the purposes of navigation. Power, speed, and certainty of action have been attained on the most gigantic scale. The celerity with which a modern steamer, with a thousand tons of merchandise and some hundreds of human beings on board, cleaves the water and pursues her course, far surpasses the most sanguine expectations of a quarter of a century ago, and indeed almost rivals the speed of the locomotive itself. Previous to 1812 our intercourse with foreign countries and with our colonial possessions depended entirely upon the state of the weather. It was only in favourable seasons that a passage was open, and we had often to wait days, or even a week, before Dublin could be reached from Holyhead. Now this distance of sixty-three miles is accomplished in all weathers in little more than three hours. The passage to America used to occupy six weeks or two months; now it is accomplished in eight or nine days. The passage round the Cape to India is reduced from nearly half a year to less than a third of that time, while that country may be reached by the overland route in less than a month.

These are a few of the benefits derived from steam navigation, and, as it is yet far from perfect, we may reasonably calculate on still greater advantages in our intercourse with distant nations. I will not here enter on the subject of the numerous improvements which have so rapidly advanced the progress of this important service. Suffice it to observe that the paddle-wheel system of propulsion has maintained its superiority over every other method yet adopted for the attainment of speed, as by it the best results are obtained with the least expenditure of power. In ships of war the screw is indispensable, on account of the security it affords to the engines and machinery, from their position in the hold below the water-line, and because of the facility it offers in the use of sails, when the screw is raised from its position in the well to a recess in the stern prepared for that purpose. It is also preferable in ships which require auxiliary power in calms and adverse winds, so as to expedite the voyage and effect a considerable saving upon the freight.

The public mind had scarcely recovered itself from the changes which steam navigation had caused, and the impulse

it had given to commerce, when a new and even more gigantic power of locomotion was inaugurated. Less than a quarter of a century had elapsed since the first steamboats floated on the waters of the Hudson and the Clyde, when the achievements thence resulting were followed by the application of the same agency to the almost superhuman flight of the locomotive and its attendant train. I well remember the competition at Rainhill in 1830, and the incredulity everywhere evinced at the proposal to run locomotives at twenty miles an hour. Neither George Stephenson himself, nor anyone else, had at that time the most distant idea of the capabilities of the railway system. On the contrary, it was generally considered impossible to exceed ten or twelve miles an hour; and our present high velocities, due to high-pressure steam and the tubular system of boilers, have surpassed the most sanguine expectations of engineers. The sagacity of George Stephenson at once seized upon the suggestions of Henry Booth, to employ tubular boilers; and that, united to the blast-pipe, previously known, has been the means of effecting all the wonders we now witness in a system that has done more for the development of practical science, and the civilization of man, than any discovery since the days of Adam.

From a consideration of the changes which have been effected in the means for the interchange of commodities, I pass on to examine the progress which has been made in their production. And, as the steam-engine has been the basis of all our modern manufacturing industry, I shall glance at the steps by which it has been perfected. Passing over the somewhat mythical fame of the Marquis of Worcester and the labours of Savery, Beighton, and Newcomen, we come at once to discuss the state of mechanical art at the time when James Watt brought his gigantic powers to the improvement of the steam-engine. At that time the tools were of the rudest construction, nearly everything being done by hand, and, in consequence, wood was much more extensively employed than iron. Under these circumstances Watt invented separate condensation, rendered the engine double-acting, and converted its rectilinear motion into a circular one, suitable for the purposes of manufacture. But the discovery at first made little way, the public did not understand it, and a series of years elapsed before the difficulties, commercial and mechanical, which opposed its application, could be overcome. When the certainty of success had been demonstrated, Watt was harrassed by infringements of his patent, and lawsuits for the maintenance of his rights. Inventors, and pretended inventors, set up claims, and entered into combination with manufacturers, miners, and others, to destroy the patent and deprive him of the just fruits of his labour and genius. Such is the selfish heartlessness of mankind in dealing with discoveries not their own, but from which they expect to derive benefit. The steam-engine, since it was introduced by Watt, has changed our habits in almost every condition of life. Things which were luxuries have become necessaries, and it has given to the poor man in all countries in which it exists a degree of comfort and independence and a participation in intellectual culture unknown before its introduction. It has increased our manufactures tenfold, and has lessened the barriers which time and space interpose. It ploughs the land and winnows and grinds the corn. It spins and weaves our textile fabrics. In mining it pumps, winds, and crushes the ore. It performs these things with powers so great and so energetic as to astonish us at their immensity, while they are at the same time perfectly docile, and completely under human control. In war it furnishes the means of aggression, as in peace it affords the bonds of conciliation, and, in fact, places within reach a power which, properly applied, produces harmony and good will among men, and leads to the happiest results in every condition of human existence. We may, therefore, well be proud of the honour conferred on this country as the cradle of its origin, and as having fostered its development from its earliest applications to its present high state of perfection. I cannot conclude this notice of the steam-engine without observing the changes it is destined to effect in the cultivation of the soil. It is but a short time since it was thought inapplicable to agricultural purposes from its great weight and expense. But more recent experience has proved this to be a mistake, and already in most districts we find that it has been pressed into the service of the farm. The small locomotive, mounted on a frame with four wheels, travels from village to village with its attendant, the thrashing machine, performing the operations of thrashing, winnowing, and cleansing, at less than one-half the cost by the old and tedious process of hand-labour. Its application to ploughing and tillage on a large scale is, in my opinion, still in its infancy, and I doubt not that many members of this Association will live to see the steam-plough in operation over the whole length and breath of the land. Much has to be done before this important change can be successfully accomplished; but, with the aid of the agriculturist preparing the land so as to meet the requirements of steam machinery, we may reasonably look forward to a new era in the cultivation of the soil. The extraordinary developments of practical science in our system of textile manufacture are, however, not entirely due to the steam-engine, although they are now in a great measure dependent on it. The machinery of these manufactures had its origin before the steam-engine had been applied, except for mining purposes; and the inventions of Arkwright, Hargreaves, and Crompton were not conceived under the impression that steam would be their moving power. On the contrary, they depended upon water; and the cotton machinery of this district had attained considerable perfection before steam came to the aid of the manufacturer, and ultimately enabled him to increase the production to its present enormous extent.

I shall not attempt a description of the machinery of the textile manufactures, because ocular inspection will be far more acceptable. I can only refer you to a list of establishments in which you may examine their operations on a large scale, and which I earnestly recommend to your attention. I may, however, advert to a few of the improvements which have marked the progress of the manufacturing system in this country. When Arkwright patented his water-frames in 1767, the annual consumption of cotton was about 4,000,000lb. weight. Now it is 1,200,000,000lb. weight—300 times as much. Within half a century the number of spindles at work, spinning cotton alone, has increased ten-fold; while, by superior mechanism, each spindle produces fifty per cent. more yarn than on the old system. Hence the importance to which the cotton trade has risen, equalling at the present time the whole revenue of the three kingdoms, or 70,000,000*l.* sterling per annum. As late as 1820 the power-loom was not in existence; now it produces about 14,000,000 yards of cloth, or, in more familiar terms, nearly 8000 miles of cloth per diem. I give these particulars to show the immense power of production of this country, and to afford some conception of the number and quality of the machines which effect such wonderful results. Mule spinning was introduced by Crompton, in 1787, with about twenty spindles to each machine. The powers of the machine were, however, rapidly increased; and now it has been so perfected that 2000 or even 3000 spindles are directed by a single person. At first the winding on, or forming the shape of the cop, was performed by hand; but this has been superseded by rendering the machine automatic, so that it now performs the whole operation of drawing, stretching, and twisting the thread, and winding it on to the exact form, ready for the reel or shuttle as may be required. These and other improvements in carding, roving, combing, spinning, and weaving, have established in this country an entirely new system of industry; it has given employment to greatly increased numbers, and a more intelligent class of work-people. Similarly important improvements have been applied to the machinery employed in the manufacture of silk, flax, and wool; and we have only to watch the processes in these different departments to be convinced that they owe much to the development of the cotton manufacture. In the manufacture of worsted, the spinning-jenny was not employed at Bradford until 1790, nor the power-loom until about 1825. The production of fancy or mixed goods from alpaca and mohair wool, introduced to this country in 1836, is, perhaps, the most striking example of a new creation in the art of manufacture, and is chiefly due to Mr. Titus Salt, in whose immense palace of industry, at Saltaire, it may be seen in the greatest perfection. In flax machinery, the late Sir Peter Fairbairn was one of the most successful inventors, and his improvements have contributed to the rapid extension of this manufacture.

I might greatly extend this description of our manufacturing industry, but I must for the present be brief, in order to point out the dependence of all these improvements on the iron and coal so widely distributed among the mineral treasures of our island. We are highly favoured in the abundance of these minerals, deposited with an un-

sparing hand by the great Author of Nature, under so slight a covering as to bring them within reach of the miner's art. To them we owe our present high state of perfection in the useful arts; and to their extended application we may safely attribute our national progress and wealth. So that, looking to the many blessings which we daily and hourly receive from these sources alone, we are impressed with devotional feelings of gratitude to the Almighty for the manifold bounties He has bestowed on us. Previously to the inventions of Henry Court, the manufacture of wrought iron was of the most crude and primitive description. A hearth and a pair of bellows was all that was employed. But since the introduction of puddling, the iron-masters have increased the production to an extraordinary extent, down to the present time, when processes for the direct conversion of wrought iron on a large scale are being attempted. A consecutive series of chemical researches into the different processes, from the calcining of the ore to the production of the bar, carried on by Dr. Percy and others, has led to a revolution in the manufacture of iron; and although it is at the present moment in a state of transition, it nevertheless requires no very great discernment to perceive that steel and iron of any required tenacity will be made in the same furnace, with a facility and certainty never before attained. This has been effected to some extent by improvements in puddling; but the process of Mr. Bessemer—first made known at the meeting of this Association at Cheltenham—affords the highest promise of certainty and perfection in the operation of converting the melted pig direct into steel or iron, and as likely to lead to the most important developments in this manufacture. These improvements in the production of the material must, in their turn, stimulate its application on a large scale and lead to new constructions.

In iron shipbuilding an immense field is opening before us. Our wooden walls have to all appearance seen their last days; and as one of the early pioneers in iron construction, as applied to shipbuilding, I am highly gratified to witness a change of opinion that augurs well for the security of the liberties of the country. From the commencement of iron shipbuilding in 1830 to the present time, there could only be one opinion among those best acquainted with the subject, namely, that iron must eventually supersede timber in every form of naval construction. The large ocean steamers, the *Himalaya*, the *Persia*, and the *Great Eastern*, abundantly show what can be done with iron, and we have only to look at the new system of casing ships with armour plates, to be convinced that we can no longer build wooden vessels of war with safety to our naval superiority and the best interests of the country. I give no opinion as to the details of the reconstruction of the Navy—that is reserved for another place—but I may state that I am fully persuaded that the whole of our ships of war must be rebuilt of iron, and defended with iron armour calculated to resist projectiles of the heaviest description at high volocities. In the earlier stages of iron shipbuilding, I believe I was the first to show, by a long series of experiments, the superiority of wrought iron over every other description of material in security and strength, when judiciously applied in the construction of ships of every class. Other considerations, however, affect the question of vessels of war; and although numerous experiments were made, yet none of the targets were on a scale sufficient to resist more than a six-pounder shot. It was reserved for our scientific neighbours, the French, to introduce thick iron plates as a defensive armour for ships. The success which has attended the adoption of this new system of defence affords the prospect of invulnerable ships of war, and hence the desire of the Government to remodel the Navy on an entirely new principle of construction, in order that we may retain its superiority as the great bulwark of the nation. A committee has been appointed by the War-office and the Admiralty for the purpose of carrying out a scientific investigation of the subject, so as to determine, first, the best description of material to resist projectiles; secondly, the best method of fastening and applying that material to the sides of ships and land fortifications; and, lastly, the thickness necessary to resist the different descriptions of ordnance.

It is asserted, probably with truth, that whatever thickness of plates is adopted for casing ships, guns will be constructed capable of destroying them. But their destruction will even then be a work of time, and I believe, from what I have seen in recent experiments, that with proper armour it would require, not only the most powerful ordnance, but also a great concentration of fire, before fracture will ensue. If this be the case, a well-constructed iron ship, covered with sound plates of the proper thickness, firmly attached to its sides, will, for a considerable time, resist the heaviest guns which can be brought to bear against it, and be practically shot-proof. But our present means are inadequate for the production of large masses of iron, and we may trust that, with new tools and machinery, and the skill, energy, and perseverance of our manufacturers, every difficulty will be overcome, and armour plates produced which will resist the heaviest existing ordnance. The rifling of heavy ordnance, the introduction of wrought iron, and the new principle of construction with strained hoops, have given to all countries the means of increasing enormously the destructive power of their ordnance. One of the results of this introduction of wrought iron and correct principles of manufacture, is the reduction of the weight of the new guns to about two-thirds the weight of the older cast-iron ordnance. Hence follows the facility with which guns of much greater power can be worked, while the range and precision of fire are at the same time increased. But these improvements cannot be confined to ourselves. Other nations are increasing the power and range of their artillery in a similar degree, and the energies of the nation must, therefore, be directed to maintain the superiority of our Navy in armour as well as in armament.

We have already seen a new era in the history of the construction of bridges, resulting from the use of iron; and we have only to examine those of the tubular form over the Conway and Menai Straits to be convinced of the durability, strength, and lightness of tubular constructions applied to the support of railways or common roads in spans which ten years ago were considered beyond the reach of human skill. When it is considered that stone bridges do not exceed 150 feet in span, nor cast-iron bridges 250 feet, we can estimate the progress which has been made in crossing rivers 400 or 500 feet in width, without any support at the middle of the stream. Even spans greatly in excess of this may be bridged over with safety, provided we do not exceed 1800 to 2000 feet, when the structure would be destroyed by its own weight.

It is to the exactitude and accuracy of our machine tools that our machinery of the present time owes its smoothness of motion and certainty of action. When I first entered this city the whole of the machinery was executed by hand. There were neither planing, slotting, nor shaping-machines, and, with the exception of very imperfect lathes and a few drills, the preparatory operations of construction were effected entirely by the hands of the workmen. Now everything is done by machine tools with a degree of accuracy which the unaided hand could never accomplish. The automaton, or self-acting machine tool, has within itself an almost creative power; in fact, so great are its powers of adaptation, that there is no operation of the human hand that it does not imitate. For many of these improvements the country is indebted to the genius of our townsmen, Mr. Richard Roberts and Mr. Joseph Whitworth. The importance of these constructive machines is, moreover, strikingly exemplified in the Government Works at Woolwich and at Enfield, chiefly arranged under the direction of Mr. Anderson, the present inspector of machinery, to whose skill and ingenuity the country is greatly indebted for the efficient state of those great arsenals.

Among the changes which have largely contributed to the comfort and enjoyment of life, are the improvements in the sanitary condition of towns. These belong probably to the province of social rather than mechanical science; but I cannot omit to notice some of the great works that have of late years been constructed for the supply of water and for the drainage of towns. In former days 10 gallons of water to each person per day was considered an ample allowance. Now, 30 gallons is much nearer the rate of consumption. I may instance the water-works of this city and of Liverpool, each of which yield a supply of from 20 to 30 gallons of water to each inhabitant. In the former case the water is collected from the Cheshire and Derbyshire hills, and, after being conveyed in tunnels and aqueducts a distance of 10 miles to a reservoir, where it is strained and purified, it is ultimately taken a further distance of 8 miles in pipes, in a perfectly pure state, ready for distribution. The greatest undertaking of this kind, however, yet accomplished is that by which the pure waters of Loch Katrine are distributed to the city of Glasgow. This work, recently completed by Mr. Bateman, who was also the constructor of the waterworks of this city, is of the most gigantic character, the water being

conveyed in a covered tunnel a distance of 27 miles through an almost impassable country to the service reservoir, about 8 miles from Glasgow. By this means 40 million gallons of water per day are conveyed through the hills which flank Ben Lomond, and after traversing the sides of Loch Chon and Loch Aird, are finally discharged into the Mudgdock Basin, where the water is impounded for distribution. We may reasonably look forward to an extension of similar benefits to the metropolis, by the same engineer, whose energies are now directed to an examination of the pure fountains of Wales, from whence the future supply of water to the great city is likely to be derived. A work of so gigantic a character may be looked upon as problematical, but when it is known that six or seven millions of money would be sufficient for its execution, I can see no reason why an undertaking of so much consequence to the health of London should not ultimately be accomplished.

In leaving this subject, I cannot refrain from an expression of deep regret at the loss which science has sustained through the death of one of our Vice-Presidents, the late Professor Hodgkinson. For a long series of years he and I worked together in the same field of scientific research, and our labours are recorded in the *Transactions* of this and other Associations. To Mr. Hodgkinson we owe the determination of the true form of cast iron beams, or section of greatest strength; the law of the elasticity of iron under tensile and compressive forces; and the laws of resistance of columns to compression. I look back to the days of our joint labour with unalloyed pleasure and satisfaction.

I regret to say that another of our Vice-Presidents, my friend, Mr. Joseph Whitworth, is unable to be present with us through serious, but I hope not dangerous, illness. To Mr. Whitworth mechanical science is indebted for some of the most accurate and delicate pieces of mechanism ever executed; and the exactitude he has introduced into every mechanical operation will long continue to be the admiration of posterity. His system of screw threads and gauges is now in general use throughout Europe. We owe to him a machine for measuring with accuracy to the millionth of an inch, employed in the production of standard gauges; and his laborious and interesting experiments on rifled ordnance have resulted in the production of a rifled small arm and gun which have never been surpassed for range and precision of fire. It is with pain that I have to refer to the cause which deprives me of his presence and support at this meeting.

A brief allusion must be made to that marvellous discovery which has given to the present generation the power to turn the spark of heaven to the uses of speech, to transmit along the slender wire for a thousand miles a current of electricity that renders intelligible words and thoughts. This wonderful discovery, so familiar to us, and so useful in our communications to every part of the globe, we owe to Wheatstone, Thomson, De la Rive, and others. In land telegraphy the chief difficulties have been surmounted, but in submarine telegraphy much remains to be accomplished. Failures have been repeated so often as to call for a Commission on the part of the Government to inquire into the causes, and the best means of overcoming the difficulties which present themselves. I had the honour to serve on that Commission, and I believe that from the report, and mass of evidence and experimental research accumulated, the public will derive very important information. It is well known that three conditions are essential to success in the construction of ocean telegraphs—perfect insulation, external protection, and appropriate apparatus for laying the cable safely on its ocean bed. That we are far from having succeeded in fulfilling these conditions is evident from the fact that out of 12,000 miles of submarine cable which have been laid since 1851, only 3000 miles are actually in working order; so that three-fourths may be considered as a failure and loss to the country. The insulators hitherto employed are subject to deterioration from mechanical violence, from chemical decomposition or decay, and from the absorption of water; but the last circumstance does not appear to influence seriously the durability of cables. Electrically, india-rubber possesses high advantages, and, next to it, Wray's compound and pure gutta percha far surpass the commercial gutta percha hitherto employed; but it remains to be seen whether the mechanical and commercial difficulties in the employment of these new materials can be successfully overcome. The external protecting covering is still a subject of anxious consideration. The objections to iron wire are its weight and liability to corrosion. Hemp has been substituted, but at present with no satisfactory result. All these difficulties, together with those connected with the coiling and paying out of the cable, will no doubt yield to careful experiment and the employment of proper instruments in its construction, and its final deposit on the bed of the ocean. Irrespective of inland and international telegraphy, a new system of communication has been introduced by Professor Wheatstone, whereby intercourse can be carried on between private families, public offices, and the works of merchants and manufacturers. This application of electric currents cannot be too highly appreciated, from its great efficiency and comparatively small expense. To show to what an extent this improvement has been carried, I may state that 1000 wires in a perfect state of insulation, may be formed into a rope not exceeding half-an-inch in diameter.

I must not sit down without directing attention to a subject of deep importance to all classes,—namely, the amount of protection inventors should receive from the laws of the country. It is the opinion of many that patent laws are injurious rather than beneficial, and that no legal protection of this kind ought to be granted: in fact, that a free trade in inventions, as in everything else should be established. I confess I am not of that opinion. Doubtless there are abuses in the working of the patent law as it at present exists, and protection is often granted to pirates and impostors, to the detriment of real inventors. This, however, does not contravene the principle of protection, but rather calls for reform and amendment. It is asserted by those who have done the least to benefit their country by inventions, that a monopoly is injurious, and that if the patent laws are defended, it should be, not on the ground of their benefit to the inventor, but on that of their utility to the nation. I believe this to be a dangerous doctrine, and I hope it will never be acted upon. I cannot see the right of the nation to appropriate the labours of a lifetime, without awarding any remuneration. The nation, in this case, receives a benefit; and assuredly the labourer is worthy of his hire. I am no friend of monopoly, but neither am I a friend of injustice; and I think that before the public are benefitted by an invention, the inventor should be rewarded either by a fourteen years' monopoly, or in some other way. Our patent laws are defective, so far as they protect pretended inventions; but they are essential to the best interests of the State in stimulating the exertions of a class of eminent men, such as Arkwright, Watt, and Crompton, whose inventions have entailed upon all countries invaluable benefits, and have done honour to the human race. To this Association is committed the task of correcting the abuses of the present system, and establishing such legal provisions as shall deal out equal justice to the inventor and the nation at large.

I must not forget that we owe very much to an entirely new and most attractive method of diffusing knowledge, admirably exemplified in the Great Exhibition of 1851, and its successors in France, Ireland and America. Most of us remember the gems of Art which were accumulated in this city during the summer of 1857, and the wonderful results they produced on all classes of the community. The improvement of taste, and the increase of practical knowledge which followed these Exhibitions have been deeply felt; and hence the prospects which are now opening before us in regard to the Exhibition of the next year cannot be too highly appreciated. That Exhibition will embrace the whole circle of the sciences, and is likely to elevate the general culture of the public to a higher standard than we have ever before attained. There will be unfolded almost every known production of art, every ingenious contrivance in machinery, and the results of discoveries in science from the earliest period. The fine arts, which constituted no part of the Exhibition of 1851, and which were only partially represented at Paris and Dublin, will be illustrated by new creations from the most distinguished masters of the modern school. Looking forwards, I venture to hope for a great success and a further development of the principle advocated by this Association—the union of Science and Art.

In conclusion, my apologies are due to you for the length of this address, and I thank you sincerely for the patient attention with which you have listened to the remarks I have had the honour to lay before you. As the President of the British Association, I feel that far beyond the consideration of merely personal qualifications, my election was intended as a compliment to practical science, and to this great and influential metropolis of manufacture, where those

who cultivate the theory of science may witness, on its grandest scale, its application to the industrial arts. As a citizen of Manchester, I venture to assure the Association that its intentions are appreciated; and to its members, as well as to the strangers who have been attracted here by this meeting, I offer a most cordial welcome.

On Thursday, the 5th inst., the Sectional Meetings commenced. The Sections are the following:—

A.—Mathematical and Physical Science.—*President:* G. B. Airey, Esq., D.C.L., F.R.S., Astronomer Royal.

B.—Chemical Science.—*President:* W. A. Miller, M.D., F.R.S., Professor of Chemistry, King's College, London.

C.—Geology.—*President:* Sir R. I. Murchison, G.C.St.S., D.C.L., F.R.S., Director-General of the Geological Survey of the United Kingdom.

D.—Zoology and Botany.—*President:* C. C. Babington, Esq., M.A., F.R.S., Professor of Botany, Cambridge.

D.—Sub-Section Physiology.

E.—Geography and Ethnology.—*President:* John Crawfurd, Esq., F.R.S., President of the Ethnological Society.

F.—Economic Science and Statistics.—*President:* William Newmarch, Esq., F.R.S.

G.—Mechanical Science.—*President:* John F. Bateman, Esq., C.E., F.R.S.

NOTICES OF BOOKS.

A Guide to Croft Spa. By Miss D. Wilkinson. Darlington: *Times'* Office. 1861.

At this season of the year the very word Spa has a refreshing look and sound to the overtasked inhabitant of a crowded city. It speaks of shady walks by bubbling streams, through leafy woods just tinged and crisped by autumn winds; and rest and solace for a jaded mind, with fresh health and vigour for a hard-worked frame. But, as chemists and reviewers, we must avoid sentiment, and proceed to business.

Croft deserves to be better known. It may be placed at the head of the list of English *Theiopegæ;* and, indeed, in respect of the amount of sulphuretted hydrogen contained in the water of one spring, it may rank before all the Continental spas except Schwiznach in Switzerland.

The village lies in a sheltered valley on the south bank of the Tees at the very edge of Yorkshire. On a gravelly soil, in the midst of a rich, luxuriant, well-cultivated country, and defended on all sides from inclement breezes, the air is dry, and pure, and mild, while the scenery around the village, if wanting in the grander aspects of Nature, presents that charming combination of hill and dale with winding stream, wood, pasture-land, and cornfield, which makes up the "quiet, delicate beauty" of an English landscape.

But the mineral springs are, of course, the principal attraction at Croft. There are four of them, three containing sulphuretted hydrogen, and another, from the absence of this gas, denominated the Sweet Well. The water of the New Spa contains a larger quantity of sulphuretted hydrogen than any other medicinal spring in England. According to the analysis of Dr. Cossar, quoted by Miss Wilkinson, it amounts to 20·56 cubic inches in the gallon; but Mr. Walker's analysis gives as much as 22·2 cubic inches. This is considerably more than is found in Harrowgate water, or in that of Weilbach, the most frequented sulphur spring on the Continent. For the various hepatic, cutaneous, and other disorders for which sulphurous waters are recommended, the Croft Springs are therefore to be preferred.

With regard to the other matters, however, our authorities differ considerably; and we place the analyses of the New Spa, by Dr. Cossar and Mr. Walker, in juxtaposition with the hint that any person interested in the prosperity of Croft had better employ a competent chemist to make an exact determination of the ingredients.

Water of New Spa. In one gallon.	Cossar. Cubic inches.	Walker. Cubic inches.
Sulphuretted hydrogen	20·56	22·2
Carbonic acid	40·216	15·2
Nitrogen and carburetted hydrogen	..	4·8
Gaseous contents	60·776	42·2
	Grains.	Grains.
Carbonate of lime	23·60	64·0
Carbonate of magnesia	4·56	..
Sulphate of lime.	141·68	8·0
Sulphate of magnesia.	13·72	67·2
Sulphate of soda.	18·82	..
Chloride of sodium	5·92	..
Chloride of calcium	..	19·2
Saline matter	208·30	158·4

Miss Wilkinson only gives Dr. Cossar's analysis, but without Mr. Walker's we should have been greatly puzzled by one sentence in her little work. She writes:—"The sulphur water is often drunk warm with a spoonful of common salt in it, which tends to strengthen the stomach, enabling it to bear the otherwise raw potency of the *chloride of calcium.*" None of this latter salt appears in the analyses our authoress quotes, and only a very small amount of chloride of sodium, so one or the other of the chemists we have named must have made some mistake in the estimation of the chlorine. The other differences are remarkable, and, as we have said, it would be well to have them settled.

There is nothing more to notice in the chemical, and the archæological and topographical information which Miss Wilkinson gives does not concern us here. We may assure our readers, however, that they will find a good account of all that is interesting in and around the neighbourhood. There is a good hotel at Croft, a respectable inn, and plenty of private lodgings, the last having "a character of aristocratic rural comfort rarely found in the more crowded watering-places." Altogether it seems to be a very desirable residence for invalids. We advise all who are recommended to a sulphur spring to consult Miss Wilkinson's little book; and let those who have no wish to mix with the fashion and gaieties of Harrowgate, who have no knowledge of French or German, whose appetites fail before foreign cookery, or whose spirits rebel against Continental police regulations, go down to Croft, and there get all the benefit to be derived from drinking or bathing in sulphur-water, with pure air and healthful exercise in quiet scenery; and then let them thank Miss Wilkinson for having brought the knowledge of the place home to them.

CORRESPONDENCE.

White Gunpowder.

To the Editor of the Chemical News.

Sir,—In reply to the letter of "J. M. C." in your Journal of August 31, respecting the grinding of white gunpowder prepared by the moist process, I beg to state that the plan now adopted is that of crushing the dry mass between wooden rollers, and then sieving; by this means it is reduced to the condition of a powder, the fineness of which will depend upon the number of meshes to the square inch of the sieve employed. I do not find that the powder has a tendency to cake, or form hard lumps when exposed to the air. I have now some samples by me, prepared upwards of a month ago, that

have been exposed to air, which have not caked to any appreciable extent.

I send a small sample of white gunpowder prepared in this way; the proportions chlorate of potash 49 parts, yellow prussiate of potash 28 parts, and cane sugar 23 parts, are those given by Dr. Pohl in your Journal. If "J. M. C." will try the experiments of grinding a portion with a tolerable amount of pressure in a stone or Wedgewood mortar, he will have no longer any doubts respecting the possibility or impossibility of its exploding (or igniting) by trituration between stones, or when struck a smart blow with a hammer, upon a stone.

I shall be happy to forward "J. M. C." a sample of white gunpowder prepared by the above-mentioned process if he will send me his address.—I am, &c.

F. Hudson.

Laboratory, 68, Corporation Street, Manchester.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Specific Gravity of Ammonia.—Jolly has made some experiments (*Annal. der Chem. und Pharm.* Bd. cxvii. s. 181), and obtained numbers which differ slightly from the determinations of others. The specific gravity of pure liquid ammonia at 0° and in relation to water at the same temperature he found to equal

I.	II.	III.
0·6239	0·6261	0·6193.

The specific gravity of gaseous ammonia relatively to that of atmospheric air at 0° and pressure 715 mm., he found to equal

I.	II.	III.
0·558	0·576	0·565

The above numbers differ a little from those given by Faraday, Biot, and Arago.

II. ANALYTICAL CHEMISTRY.

Influence of Free Ammonia and Ammoniacal Salts on the Precipitation of Nickel, Cobalt, Zinc, Manganese, Iron, and Uranium, by Sulphide of Ammonium.—Fresenius publishes (*Journ. für Prakt. Chem.* Bd. lxxxii. s. 257) the result of a long investigation undertaken to test the truth of Terreil's assertion that the presence of ammonia and ammoniacal salts hindered the complete precipitation of manganese, cobalt, nickel, and zinc by sulphide of ammonium. The author gives copious details of his experiments which sometimes confirm, but generally contradict, Terreil. We select and condense some of the results:—

Nickel.—Colourless or yellow sulphide of ammonium precipitates very slowly a salt of nickel oxide, and traces of nickel remain in solution. Sal ammoniac greatly assists the precipitation after some time. Free ammonia is most prejudicial. The precipitation is most complete with sal ammoniac and a slight excess of sulphide of ammonium.

Cobalt.—Very dilute solutions of salts of cobaltous oxide are not precipitated by sulphide of ammonium alone, even on long standing. Sal ammoniac assists the complete precipitation after a time. Ammonia hinders the complete precipitation, but only in a slight degree. Whether colourless or yellow sulphide is used, the results are the same. Under the most favourable conditions the sulphide will precipitate a solution of cobalt containing only $\frac{1}{600000}$th part.

Zinc.—Colourless sulphide of ammonium will precipitate slowly a pure neutral zinc solution. Sal ammoniac assists the complete precipitation. Free ammonia causes the precipitate to remain suspended a longer time, but beyond this has no injurious influence. With sal ammoniac the yellow sulphide answers as well as the colourless. Zinc may be precipitated from a solution containing only $\frac{1}{600000}$th part.

Manganese.—Pure sulphide of ammonium will not precipitate a very dilute manganese solution. Sal ammoniac favours the precipitation after some time. Ammonia in the presence of sal ammoniac does not appear either to assist or hinder the precipitation. Yellow and colourless sulphide appear to act very much alike; but the latter is, perhaps, to be preferred. The reagent is not so sensitive with manganese as with zinc, nickel, and cobalt, but a solution containing from $\frac{1}{100000}$ to $\frac{1}{200000}$th part is soon precipitated and in the course of time as little as $\frac{1}{400000}$th. When a manganous oxide solution was precipitated by the sulphide in the presence of sal ammoniac, the author observed that the flesh-coloured precipitate changed after some days to a green, an appearance which had never before been remarked. This change of colour is obviously caused by the passage of the hydrated sulphide of manganese into the anhydrous. The change of colour begins at one spot and gradually spreads over the whole precipitate.

Iron.—Ferrous Oxide.—Pure sulphide of ammonium, colourless or yellow, precipitates a solution of ferrous oxide slowly but completely. Sal ammoniac greatly assists the precipitation after a time. Free ammonia is not appreciably detrimental. Colourless or clear yellow sulphide has the same effect.

Ferric Oxide.—Pure sulphide of ammonium, colourless or yellow, precipitates a dilute solution of ferric oxide slowly and imperfectly, or not all. Sal ammoniac assists the precipitation. Free ammonia is no disadvantage: a small quantity may be of some advantage in hastening the precipitation. Colourless or yellow sulphide answers equally well.

Uranium.—The precipitation of uranic oxide from very dilute solutions requires a long time. Colourless sulphide appears to act somewhat quicker than yellow. Sal ammoniac promotes the precipitation after some time, and free ammonia may assist. The colour of the precipitates depends on the presence and amount of sal ammoniac, ammonia, and sulphide of ammonium.

III. ORGANIC CHEMISTRY.

The Fixation of Ammonia.—M. Schützenberger (*Bulletin de la Société Chimique de Paris*, i., p. 16) has also made experiments similar to those of M. Thenard, with analogous results. He extended his investigations to the vegetable colouring matters, and found that when these were heated with ammonia in a sealed tube, that they also fixed the gas which was not removed by the strong acids nor disengaged by hydrate of lime.

Luteoline.—The colouring matter of the woad according to Schützenberger and Paraf (*Ibid.* ii., p. 18), is easily obtained pure by extracting in a displacement apparatus with boiling alcohol. The concentrated alcoholic solution is then precipitated by water, the precipitate dried, and the luteoline separated from the resinous matter by sublimation, in which way it is obtained in beautiful golden yellow acicular crystals. The analysis of the crystals led to the formula $C_{24}\ H_8\ O_{10}$. Luteoline dissolves when heated in a sealed tube with caustic ammonia, and the solution evaporated to dryness, leaves a residue which evolves ammonia when treated with caustic potash.

MISCELLANEOUS.

THE WATER BAROMETER AT THE CRYSTAL PALACE.

The scientific visitor to the Crystal Palace will find a new object of interest in the Water Barometer which has recently been erected within the building at Sydenham. The instrument is remarkable not merely by reason of its unique character in point of construction, but bespeaks an additional claim to our notice from the circumstance of its having been originally fitted up, by Professor Daniell, against the staircase wall of the apartments occupied until

lately by the Royal Society at Somerset House, and where for nearly thirty years it has registered in a very conspicuous manner the variations of barometric pressure.

The Council of the Royal Society having placed the instrument at the disposal of Mr. Glaisher, of Greenwich Observatory, that gentleman in turn negotiated its transfer to the Directors of the Crystal Palace, who at once took steps to provide at Sydenham a convenient place for its reception and exhibition, and within the last few days the reconstruction of the instrument has been successfully accomplished by Messrs. Negretti and Zambra, of Hatton Garden. The preliminary operation of removing the barometer from Somerset House was, after much difficulty, effected by them some months since, all arriving in safety at the Palace, with the exception of the breakage of about eighteen inches from the lower end of the barometer tube. Originally the tube was filled by means of a copper steam boiler, set in brickwork over a fire-place immediately under the barometer itself, so that the tube could be lowered into the boiler which has since formed its cistern.

The original plan of erection did not appear to be that most readily available for reconstructing the instrument at the Palace; firstly, because there was doubt as to the boiler being sufficiently strong to bear the necessary pressure, so that the water might be boiled almost throughout the tube and maintained for some time in a state of ebullition, and, secondly, on account of the existing regulations at the Crystal Palace not permitting fire to be lighted within the building. Under these circumstances it was suggested by Mr. Negretti to use an auxiliary boiler outside the building, and his object was first to boil the water in the cistern, allowing the steam to escape by a cock for some time, and then, by closing the cock, to drive steam through the tube until it escaped in a strong jet from its upper extremity, and then to boil the water in the tube till it issued from the top. By this means all the air would be expelled from the tube itself, and when this operation had continued long enough to temporarily seal the top while the water was still flowing out, and ultimately, by means of a judicious use of the blowpipe, to seal hermetically the top of the tube. Mr. Negretti was engaged for three days at the Palace preparing everything, and with great dexterity joined on a new piece of glass to the lower end of the barometer tube which had been broken, and another piece of glass likewise on to the upper extremity terminating in a small aperture.

The operation of filling and sealing the tube is thus described by Mr. Glaisher:—"On Thursday, August 29, everything was ready for the experiment, an auxiliary boiler was planted outside the building for generating steam, a pipe from which led to the boiler under the barometer itself into which distilled water in sufficient quantity had been placed, precautions having been taken to connect the pipe from the outer boiler with that in the inner boiler, with a portion of flexible tubing which would first yield if anything went wrong. After the connection was made, in about half an hour a current of steam issued from the cock. When this had continued for some time, the cock was closed, and the steam ascended into the tube, being at first condensed by the upper part of the tube, and ultimately rushing out at the top with considerable velocity. Water then ascended into the tube; and it was an anxious moment to watch the boiling water reach and pass where the tube had been joined, which, however, had been so admirably performed that all anxiety on this head soon ceased. After a time the upper extremity, while steam was rushing out, was closed, when the water ascended the tube and soon reached a point 32 feet from the surface of water in the boiler below. After this it was driven up, by steam, to very nearly the top of the continuation of the tube, but it did not reach quite up to the sealing point. A consultation now took place; it was almost resolved to let well alone, but it was ultimately determined to go through the same process again, as some practical points had been suggested which promised to make the experiment yet more successful.

"The top of the tube was therefore opened, the water fell, and the operation repeated. It would be tedious to detail all the steps taken in the reboiling; the operation was eminently successful, and the tube was finally closed by the blow-pipe, and the column of water reached nearly 33 feet, without the slightest speck of air-bubble being perceptible.

"On Friday afternoon Mr. Negretti and I found the column of water 32 feet 9 inches in length, as measured from the surface in the cistern. This is equivelant to a column of 28·84 inches of mercury, considering the specific gravity of mercury as 13·624. The reading of a mercurial barometer at the same time was 29·86 inches; the difference between these two readings is 0·98 inch, and this difference should indicate the elastic force of aqueous vapour at the temperature at the time—viz., 78° if both instruments be correct. The elastic force of aqueous vapour at the temperature of 78° is 0·96 inch, differing by two hundredths of an inch only from that indicated by the water barometer, and completely satisfied me as to the accuracy of the operation, thus proving that the space above the water was free from air.

"I cannot close without expressing my sense of the ready resource of Mr. Negretti in overcoming every difficulty as it arose, and of the facility with which he performed and conducted every process connected with the operation."

The instrument is fixed in an angle of the Tropical Department, and near the great tree. The top of the column of water can be seen from the first gallery, and as that which causes a variation of an inch of mercury will cause a variation of more than a foot in the column of water, so the changes in the latter will be more than twelve times as great as in the former. Many oscillations, therefore, may be seen by the water which cannot be seen by the mercurial barometer, and in gales of wind or heavy storms it will be highly interesting to watch its action.

The principle of construction which renders this form of the barometer somewhat liable to get out of repair will not we trust materially falsify its indications for some time to come. The fact of water being a solvent for the gaseous components of the atmosphere must introduce a slight source of error, which will make itself apparent by a gradual diminution in the height of the water-column. The precautions taken against frost by the selection of the site appear fully sufficient to combat this formidable antagonist of the Water Barometer.

We may remark, in conclusion, that the Crystal Palace, from its offering such rare facilities in regard to height, appears peculiarly adapted for the exhibition of a gigantic Foucault's pendulum, which, like the philosophical instrument just now erected, would probably have an interest for the majority of the numerous visitors.

The City Gas Companies.—A joint circular has been issued by the City Gas Companies, notifying that, in consequence of the recent Act for Regulating the Supply of Gas to the Metropolis requiring, under heavy penalties, a greatly increased standard of illuminating power and purity, which will necessarily involve an increased cost of production, the Companies supplying the City of London will in future charge 4s. 6d. per 1000 ft. for the ordinary coal gas.

Phosphuretted Hydrogen.—Professor Graham has shown that phosphuretted hydrogen, although not spontaneously inflammable, becomes so when brought in contact with a small quantity of nitrous acid. M. Landolt has furnished an elegant mode of showing this fact. Some phosphuretted hydrogen, not spontaneously inflammable, prepared by heating some phosphorus with a concentrated solution of potash with double its volume

of alcohol, is directed towards a layer of nitric acid in a capsule. If the acid be about the density of 1·34, and if it is deprived of its hyponitric acid by boiling, the bubbles of phosphuretted hydrogen will traverse it without ignition. But if only a few drops of the fuming acid be added, each bubble of the gas will immediately inflame. Too much of the fuming acid will suspend the action, by decomposing the gas.

Oil Springs in America.—We have several times recently called attention to the oil springs of the United States and Canada. These springs have already become a new and increasing source of wealth. In Canada there are nearly 100 wells yielding oil. The land which contains the springs is leased in patches of acres or half acres. The lessors generally give 300 dollars for the privilege and one third of the oil drawn from the wells. A correspondent says: "The wells are sunk and cribbed to a depth of from 40 to 60 feet till the rock is reached. In many cases surface oil is found before reaching the rock, but it is of rather inferior quality and doubtful yield. After arriving at the rock, the wells through the earth being from 4 to 7 feet square, they drill to a depth of from 40 to 70 feet, between which distances oil is almost sure to be discovered. Wooden tanks, varying from 500 to 2,000 gallons capacity, are constructed close to each well. The oil is pumped into these, and afterwards drawn off into barrels to be sent to market. The cost of a well is very small. Parties are in the district making contracts for sinking wells. Their charge is, for sinking through the earth 2¼ dols. per foot, and for drilling through the rock 2½ dols. per foot. A well after being commenced usually yields oil in less than 30 days. At these prices a well can be sunk, a tank for 100 gallons made, and a pump and all necessary appliances provided for a sum equal to about 100*l.* sterling. When oil is found, one man at 4*s.* a day can readily pump 100 barrels, or 4,000 gallons a day. The cost of the oil, including every expense, and calculating the reimbursement of every outlay incurred in one year, and also calculating a yield of 15 barrels, or 600 gallons, a day, is, it is alleged, absolutely less than a halfpenny sterling a gallon delivered into the tank alongside the well. Very few attempts have yet been made to pump by steam at the place where the oil is most extensively found, nearly all the labour being by hand. This is partly to be attributed to the badness of the roads, preventing the possibility of getting heavy loads into the district, and partly to the yield of the wells being on an average about equal to the quantity a man can easily pump in a day. A moderate average yield for all the wells now in operation (100) is 15 barrels, or 600 gallons, a day. At the rate at which privileges are being disposed of and parties are preparing to sink wells, there will be 500 in operation before Christmas. Taking the present 100 wells only, however, the result is extraordinary. Thus—100 wells yielding 600 gallons give 60,000 gallons per day, 360,000 per week, or 18,720,000 per annum. A trustworthy observer remarks:—'Such a yield seems almost fabulous, and yet I believe, from personal observation and enquiry on the spot, that it is within the truth.'"

Diamonds.—In the official statistical report of the value of produce exported from Bahia, Brazil, an amount is included not exceeding 150,000*l.*, whereas an amount superior to 500,000*l.*, worth of this precious stone is clandestinely sent out of the country yearly. The discovery of the diamond mines in the district of Paraguassú, in the year 1845, has effected great and beneficial results to the population and commerce. What was in that year but a desert, is now one of the most flourishing districts, inhabited by a laborious and daily-increasing population. The town of Isabel de Paraguassú and neighbourhood contains 60,000 souls; that of Lencoés, 30,000; and Andarahy, 20,000—all the result of this discovery; and it may truly be said that those mines have realised for the poorer population of the interior, the same good we have observed in California and Australia. It has opened a large field to all without dependence on professional skill or capital, of which the majority were not possessed; and in a moral sense has operated wonders in reclaiming the vicious from habits of indolence and crime. These men, finding in the extraction of diamonds an advantageous profit, naturally became large consumers of the produce of the country, which, for the want of market, was not cultivated; and altering their habits of life, increased their well-being, and eventually made them consumers of the produce of foreign countries. The town of St. Isabel de Paraguassú is now the chief depôt of the trade of the north-west of this province, and supplies all the interior populations with the comforts of European civilisation, a population calculated at no less than 700,000 souls. In the neighbourhood of St. Isabel the cotton plant flourishes, and nitrate of soda is found—but the great difficulty to the exportation of these valuable products is the want of a good road to this port. Last year I used all my influence and endeavours with the late President to promote the passing of a law in the Assembly, guaranteeing five per cent. on the capital expended in the construction of a good carriage road. The law was passed and duly sanctioned by the late President, but, unfortunately, that law has been revoked. To give an idea of the importance of the road in question, it is enough to state that goods (foreign) to the value of 600,000*l.* to 1,000,000*l.* sterling are annually sent to the diamond district from this city, and that its exports in diamonds average between 600,000*l.* to 800,000*l.* per annum; no calculation being possible of the value of cotton, nitrate of soda, hides, skins, cattle, iron, &c., &c., that would be sent down, had the road I had so strongly recommended been carried into execution.—*Extract from the Report of H. B. M. Consul.*

ANSWERS TO CORRESPONDENTS.

Kofos and Adolphe.—Received.

J. S. Blockey.—Your suggestion is received with thanks, and will be attended to if practicable.

Applied Chemistry, by M. Barreswill.—Will the correspondent who last week left at our office a short paper with the above heading, favour us with the second part?

Tri-ethyl-phosphine.—A correspondent wishes to be informed of the best method of preparing this new reagent for bisulphide of carbon in coal gas.

T. King.—1. Professor Johnstone has written an excellent little work on "The Analysis of Soils and Manures," and we believe Mr. Nesbit, of Kennington, has also published a similar volume. 2. At the Government School of Mines, Jermyn Street, or at Chapman and Hall's.

Errata.—In the article "Researches on the Assay of Silver," in our last No., p. 125, fourth line, *for* "double salt KO +," *read* "SO_3KO +." The last three lines (in p. 127) should read thus:—"A little chlorine soon prohibits its further formation. This, also, is an interesting instance of the influence of quantity on chemical affinity."

Ventilation.—A correspondent has drawn our attention to the subjoined extract from the *Scientific American* of the 31st ult.:—"An English journal says that 'the new system of ventilation, patented by the National Ventilation Company, consists in a nice adaptation of wire-gauze to open windows, so that the air is allowed to steal gently on and out, while violent draughts, and those enemies to ventilation, the blacks, are excluded.' We should like to know what on earth is new about this mode of ventilation that it should attract the attention of the National Ventilation Company. The same thing is in extensive use in this country, and has been for years—used for the double purpose of ventilation and to keep out noxious insects."

Nitro-Prusside of Sodium.—Theophilus.—This reagent is prepared by treating 2 parts of powdered ferrocyanide of potassium with 5 parts of common nitric acid previously diluted with its own volume of water. The solution, after the evolution of gas has ceased, is digested on the water-bath until salts of protoxide of iron no longer yield a blue but a slate-coloured precipitate. The liquid is now allowed to cool, when much nitrate of potash and occasionally oxamide is deposited; it is filtered and neutralised with carbonate of soda which yields a green or brown precipitate and furnishes a ruby-coloured filtrate. This, on evaporation, gives a crystallization of nitrate of potassa and soda together with the new salt. The crystals of the latter are selected and purified by crystallization; they are rhombic, and of a splendid ruby colour.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Transformation of Monobromated Propylene into a New Hydrocarbide of the Composition, C_3H_4, by M. SAWITSCH.

IN a paper on the preparation of acetylene by bromated ethylene, I ventured the opinion that by applying the same method to the superior homologues of this body, the series of hydrocarbides $C_n H_{2n-2}$ would be obtained. Experience has fully confirmed my opinions, at least in that which concerns the second part of the series. In fact, by submitting monobromated propylene to the action of soda alcohols, one equivalent of hydrobromic acid may be taken away, transforming it into a carbide, C_3H_4, to which I have given the name of *allylène*.[1]

The details of the operation are identical with those I have already pointed out with respect to acetylene, with this difference, that ethylate was substituted for acetylate of soda. When the balloon, previously cooled, in which the reaction took place was opened, a considerable quantity of a gaseous mixture was disengaged,[2] which was several times passed through a solution of ammoniacal oxide of copper, in which it deposited a large, flaky, canary-yellow precipitate, possessing the following properties:—Heated, it decomposes with deflagration and the production of a reddish flame; thrown into bromine, it is destroyed, occasioning a rustling sound, accompanied by a red flame; finally, cold, concentrated acids immediately disengage gas from it, which is set free under the influence of diluted acid, particularly of hydrochloric acid, but only by the application of heat.

This last reaction is utilised in the preparation of pure allylène. This gas is colourless, with a strong and disagreeable odour, though less so than that of acetylene. It burns with a brilliant, fuliginous flame. It precipitates mercurous and argentine solutions,—the former dark gray, the latter white. These two combinations having a composition probably analogous to cuprous compounds, are, like them, unstable; they decompose by heat, the former without detonation, the latter with an explosion and a reddish flame.

The endiometric analysis of the gas gives the following results:—

Temperature . . .	13°
Barometer	0·763m′
Volume of gas . . .	2·69 c. c.
Volume of oxygen added .	21·92 „
Total volume . . .	24·61 „
After	19·10 „
After potassa . . .	11·02 „

[1] This name was previously proposed by M. Berthelot in his work on Organic Chemistry, vol. ii., p. 161.

[2] Twenty-five grammes of monobromated propylene have yielded about three litres of gas. To extract the whole, the balloon must be gradually heated to the boiling point of alcohol, in which allylène is soluble.

	Experiment.	Theory.
	c. c.	c. c.
Disappeared . .	5·51	5·38
Carbonic acid formed	8·08	8·07
Oxygen consumed .	10·90	10·76

or, by comparing the results of experiment with one volume of gas:—

Contraction . .	2·04	2·00
Carbonic acid . .	3·00	3·00
Oxygen consumed .	4·05	4·00

I had not sufficient gas at my disposal to enable me to determine its density, and thus to corroborate the formula, $C_3H_4 = 2$ vols., which, nevertheless, seems to me incontestable, looking to the mode of formation of this body, to its composition, and to the similarity of its properties with those of acetylene, respecting whose formula no doubt can be entertained. The curious property of precipitating ammoniacal solutions of copper, which has enabled me to isolate allylène, seems to be characteristic of the hydrocarbides of this series, at least, judging from the two first terms. There is good reason to believe that it will lead to the discovery of higher terms.

I propose soon to return to the study of the physical and chemical properties of allylène and its derivatives. At present I confine myself to the mention of bromide of allylène, a limpid and colourless liquid, smelling like tribromide of allyle, and which I obtained by dropping allylene into bromine.

It may not be needless to remark, that, in order to obtain every desirable guarantee of the purity of the gas, I employed monobromated propylene, prepared by means of propylene gas, proceeding from the reduction of iodide of allyle by mercury and hydrochloric acid. In my opinion, this is the only way to obtain pure bromated propylene.

These researches were made in M. Wurtz's laboratory. —*Comptes-Rendus.*

On the Presence of Nitrates in Mineral Waters, and on the Production of Saltpetre, by R. HAINES, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

IN September, 1851, the Medical Board sent me for analysis five bottles of well-water from Aden, each from a different well. These waters were all clear and colourless, neutral to test-paper, and of a more or less bitter, nauseous, saline taste, like a dilute solution of Epsom salts.

The analysis was conducted in the usual way; but from the small quantity of each water available, it was necessary to economise the supply as much as possible, and any attempt to estimate the less abundant constituents, as bromine, iodine, fluorine, &c., was out of the question.

The first process in these analyses is usually to evaporate

a portion of the water to dryness, with the view of ascertaining the total amount of solid matter.

The object of this is merely to give a check upon the total of separate constituents. Afterwards each constituent is estimated by itself, a fresh portion of water being used, if possible, for each. In the present case, as soon as the evaporation had proceeded so far as to cause the commencement of crystallisation, pungent fumes of hydrochloric acid began to be given off in abundance. This was evidently owing to the presence of chloride of magnesium, which, like chloride of aluminium, is decomposed on evaporating its solution into the base and hydrochloric acid. As, from the small quantity of water sent me, I was obliged to employ the dry saline mass for the purpose of estimating some of the constituents, I did not dry the mass completely enough (that is, at a high temperature) to make its weight an efficient control on the subsequent analysis, which, if I could have foreseen what afterwards occurred, I should certainly have done.

On summing up the amounts of acids and bases obtained,—hydrochloric and sulphuric acids, soda, lime, and magnesia,—I was surprised to find that in four out of the five cases the acids were quite insufficient to neutralise the bases; in the fifth case the difference was unimportant. I naturally suspected some error in my analysis, and repeated a few of the processes with such small quantities of water as I could spare, without finding any errors of importance. I was driven, therefore, to seek for some other acid which must have escaped detection. Phosphoric acid was sought for in vain; but on applying the tests for nitric acid, it at once appeared that, in the very four cases mentioned, it was present in abundance, while in the fifth mere traces of it were found.

There are some substances which, from peculiar circumstances, it is difficult to estimate quantitatively in a direct manner, and it has, therefore, been usual in compounds containing them to weigh all the other ingredients, and then set down the difference which remains unaccounted for as their weight. Boracic and nitric acids are of this class. The only method recommended for directly estimating the nitric acid of mineral waters was to precipitate the chlorine, iodine, and bromine by sulphate of silver, and then to distil the concentrated liquid with an excess of sulphuric acid. Nitric acid with a little sulphuric acid comes over into the receiver in which a solution of baryta is placed, with which the acids combine. By then slowly evaporating the solution to dryness in the air, the free baryta is converted into carbonate; water leaves the carbonate, and sulphuric acid dissolves the nitrate, in which the baryta being estimated by sulphuric acid in the usual way, the quantity of nitric acid equivalent to it is found. This is a very round-about process, and the distillation especially is most objectionable. The retort is pretty sure to break, unless a sand-bath is used, which retards the operation, and it is quite impossible to bring over the whole of the acid, which remains hanging about the body and neck of the retort. However, with the very small quantity of water that remained, I tried the process, and in one case succeeded in obtaining five-eighths of the whole quantity of nitric acid to be accounted for; in the other cases the loss was much greater. I was obliged, therefore, to rest contented with estimating the nitric acid by difference.[1]

[1] Far superior modes of estimating nitric acid have been introduced within the last ten or twelve years, but I was not then acquainted with them.

The waters from Aden were named as follows:—1, Banian well; 2, Parsee well; 3, Turkish well; 4, Jaffron well; and 5, Lower Tawella. Their composition is given in the accompanying tables; the specific gravities were taken at the temperature of the atmosphere, and reduced by calculation to 60°, the expansion being assumed to be the same as that of pure water. The quantity to which the contents are referred is the imperial pint of 8750 grain measures, or one-eighth of an imperial gallon.

Names of Wells.	Banian.	Parsee.	Turkish Well.	Jaffron.	Lower Tawella.
Specific gravity at 60°.	1007·2	1005·2	1005·1	1007·9	1004·4
	Grains.	Grains.	Grains.	Grains.	Grains.
Constituents found:—					
Chlorine	32·078	30·507	29·459	41·170	23·247
Sulphuric acid	6·771	3·746	4·130	7·496	2·765
Nitric acid..	8·081	3·010	2·577	5·766	..
Magnesia	3·802	4·326	4·159	5·427	2·389
Lime	10·833	7.381	6·315	7·645	7·119
Soda	20·563	16 816	17·755	28·773	11·313
Carbonates of lime and magnesia	0·303	0·275	0·349	0.397	0·443
Silica	0·466	0·271	0·393	0·332	0·525
Arranged as:—					
Chloride of sodium ..	28·815	26·071	27·019	43·033	17·178
Sulphate of soda.. ..	11·980	6·670	7·353	13·345	4·923
Chloride of magnesium..	8·842	10·060	9·595	12·622	5·558
Chloride of calcium ..	12·909	11·627	9·671	8 324	13·967
Nitrate of lime	12·332	4·576	3·935	8·657	..
Carbonates of lime and magnesia	0·303	0·275	0·349	0·397	0·443
Silica	0·466	0·271	0·393	0·332	0 525
Total solids	75·647	59·550	58·315	86·710	42·594
Carbonic acid, cu. in. ..	0·481	1·190	0 961	0·481	0 744

I was until lately under the impression that this was the first time the water of the Aden wells had been analysed. I find, however, that some years previously Dr. Giraud had cursorily examined seven specimens of such waters, at the instance of the Medical Board, with the following result, which he has kindly allowed me to communicate. I have added the third and fifth columns for the sake of comparison with my analyses:—

Name.	Specific gravity of distilled water = 1000.		Saline contents.	
	At 80° F.	At 60° F.	In 2000 grains.	In an Imperial pint.
1. Banian Well ..	999	1002	1·16	5·08
2. Bir ud Dowla ..	999	1002	1·50	6·08
3. Bir Zaweel	1000	1003	2·75	12·07
4. Gaol Well	1001	1004	5·58	24·50
5 Bir Senar	1001	1004	8·41	36·94
6. Bir Zaffran	1002	1005	10·04	44·15
7. Un-named	1000	1003	8 70	38·18
8. Ras Mei[2] (contained bromine)	..	..	59·00	258·12

No quantitative analysis was then made, but Dr. Giraud remarks that No. 7 contained a large quantity of salts of lime.

Amongst these waters, there are only two which bear the same name as those in my list, the Banian well and the Zaffran well. Whether the Zaweel is the same as

[2] From a well experimentally sunk on the Isthmus, very near the sea, at the south-eastern extremity of the inner line of fortification, at the foot of the rocks, the water was at first sweet, but after a time the sea appeared to penetrate into it, and it became useless. (See Lieut. Wilkins' Report.)

the Lower Tawella of my list is doubtful. But the difference in character of those two, as they appear in the two lists, is so great as not to be easily reconciled; either there must be some confusion of names, or the water of the wells is liable to very great variation in quality. Perhaps some of the officers at Aden may be able to clear up this point. A list of the various wells in Aden, with an exact description of their localities, and other particulars, is much wanted.

The discovery of so large a quantity of nitric acid in well water was at the time, I believe, unparalleled; but a few years after other cases of a similar nature were found to occur, and on this side of India. In 1854 some water was sent for analysis from Nassick, drawn from a certain well in the gaol, which water was so impregnated with salts as to be unfit for any purpose but that of washing. Dr. Giraud found it to contain so much nitric acid that "on evaporating the water to dryness, and igniting the residue, copious red fumes of nitrous and hypo-nitrous acids were disengaged from the decomposition of the nitric acid of the nitrates, by the organic matter previously held in solution in the water."[3] Again, in the following year, four samples of water, from different wells in the town of Nassick, being sent for analysis, three of them proved to be ordinary spring water, of tolerable purity; but the fourth, from the "Bhunder Kallee" well, was found to be even more strongly impregnated with nitrates than that from the gaol. In this case, also, copious red fumes were given off in heating the saline residue. The proportion of silica, too, appears most unusually large; perhaps the sulphate of lime was not thoroughly extracted from it. The composition of these waters is given below. I have added a column with a view to facilitate comparison with my analysis of the waters from Aden. The nitric acid is estimated by difference. The water from the Nassick wells is said to vary very much according to the season of the year. These waters were drawn in October and November.

	Gaol Well.		Bhunder Kallee Well.	
Specific gravity .. {	At 80° 1002· At 60° 1004·5		At 80° 1004. At 60° 1006·5	
Constituents found:—	In 10,000 grs.	In impl. pint.	In 10,000 grs.	In impl. pint.
	Grains.	Grains.	Grains.	Grains.
Chlorine (total) ..	5·6000	4·922	12·052	10· 14
Sulphuric acid ..	0·9974	0·877	4·021	3·541
Nitric acid	..	(13·170)	22·655	19 951
Chloride sodium ..	8·4150	7·395	..	..
Soda	..	..	10 638	9·367
Lime	4·0254	3·538	7·305	6·432
Magesia	3·7000	3·262	5·429	4·7·0
Silica	..	..	3·260	2·871
Arranged as:—				
Chloride sodium ..	8·4150	7·395	19·972	17·590
Sulphate lime ..	1·7064	1·499	6·879	6·058
Nitrate lime	9·5992	8·436	12·896	11·356
Nitrate magnesia ..	12·2810	10 802	19·635	17·291
Chloride magnesium	0·6940	0·609	..	..
Silica	..	..	3·260	2·871
Total solids ..	32·6956	28·741	62·642	55·166

(To be continued.)

[3] Might not the red fumes rather be partly owing to the reaction of the hydrochloric acid disengaged from the hydrated chloride of magnesium, on the nitrates producing chlorine and chloro-nitric gases?

On Perchloric Acid and its Hydrates,[1] *by Professor* Roscoe.

All the knowledge we possess of the quantitative relations of perchloric acid is the determination of the composition of the potassium salt, first analysed by Stadion, in 1816, and afterwards by many other chemists. The perchloric anhydride has not been isolated, and no analysis of the aqueous acid has ever been made. We can only account for the neglect with which chemists have treated the highest and yet the most stable of the oxides of chlorine, by the fact that the preparation of the acid in large quantities has been attended with great difficulties. The best method for preparing aqueous perchloric acid is to decompose chlorate of potassium with hydrofluosilicic acid, to boil the chloric acid thus obtained down, which splits up into lower oxides of chlorine, which escape in the gaseous state, impure perchloric acid being left behind, which is purified by distillation. The acid thus obtained is in appearance not to be distinguished from oil of vitriol, being a colourless, heavy, thick, oily, corrosive liquid, giving off by heating dense white fumes. By heating the aqueous perchloric acid with four times its volume of concentrated sulphuric acid, the latter takes water from the first, dense white fumes are evolved, a yellow mobile liquid distils over, afterwards thick oily drops appear, which, when coming in contact with the yellow liquid, form white crystals, previously obtained by Serullas, but in such small quantities that he was unable to analyse that substance, which, prepared in this way, contains always sulphuric acid, and is therefore not fit for analysis, and requires redistillation. Heated, however, to 110° C., the crystals decompose, and split up again in the yellow liquid, which distils over at a low temperature, and the thick oily liquid remains in the retort. The yellow liquid thus obtained is pure perchloric acid, a body not known before, and can be obtained also by distilling one atom of perchlorate of potassium with four atoms of sulphuric acid. In the pure state it is perfectly colourless, but commonly slightly yellow, owing to the presence of lower oxides of chlorine. Perchloric acid is one of the most powerful oxidising agents known; a single drop brought into contact with charcoal, paper, wood, alcohol, &c., immediately causes explosive combustion, falling not short in violence of that of chloride of nitrogen, and brought on the skin fearful wounds are produced, which do not heal for months. Like nitric acid, it cannot be distilled without decomposition, but it darkens, and heated stronger, decomposes with explosion. It cannot be kept for any length of time; even sealed up in glass bulbs, which are placed in the dark, it decomposes suddenly after some time, smashing the vessel containing it. It mixes with water with a hissing noise and evolution of heat, uniting and forming the same crystals which were mentioned before, and were used for preparing the pure acid. Those crystals are the monohydrated perchloric acid. They melt at 50° C., and heated to 110° C., split up in pure perchloric acid, which distils over, and an oily liquid boiling at 200°, which is also obtained by boiling aqueous perchloric acid till dense white fumes are given off. That oily acid has a constant composition containing 72·3 per cent. pure perchloric acid and 27·7 per cent. of water. This per-centage corresponds, however, to no definite hydrate of simple atomic composition, but follows the same general relations respecting composition and boiling point, which,

[1] Read before the British Association.

as I have shown previously, hold good for so many aqueous acids, namely, that the phenomena of constant boiling point and constant composition depend chiefly upon physical, and not on chemical attractions.

TECHNICAL CHEMISTRY.

On the Chemical Manufactures of South Lancashire, by Drs. SCHUNCK, ROSCOE, *and* SMITH.

Sulphuric Acid.—This is an important manufacture, and quite indispensable in the production of many other articles, as well as in the manufacturing processes. To produce it economically on a large scale was of considerable importance, and a great degree of economy was practised. Few manufacturers employed sulphur, most of them using pyrites. In burning the pyrites from eight to ten of sulphur remained behind and was lost. Mr. Spence, of Manchester, had, however, reduced this loss to two. The introduction of Spanish and Portuguese pyrites had caused the rise of a new branch of industry in the extraction of a small quantity of copper which these ores contain. In Hill's process of purifying gas, hydrated peroxide of iron was used instead of lime. When the material could be no longer used for purification, it was found to contain sulphur, and Mr. Spence used this sulphur for the production of sulphuric acid. From one ton of the material he obtained about one and a-quarter ton of hydrated sulphuric acid. Mr. Harrison Blair's improved sulphur-burner was especially valuable, as economising space in the chambers, by preventing the sulphurous acid from being diluted with too large an excess of air, as is the case in the ordinary burners. The tendency in this district has been to increase the size of the sulphuric acid chambers, the largest being 112,000 cubic feet. Many manufacturers employ Gay-Lussac's method, invented sixteen or seventeen years ago, for economising nitric acid. By this means a saving of more than 50 per cent. of nitrate of soda is effected; but others do not employ this method, as with the low price of nitrate of soda, at 12*l.* per ton, it does not pay to collect and absorb the waste oxides of nitrogen. The use of platina stills for the rectification of sulphuric acid has now been almost entirely abandoned, and their place supplied by glass retorts, which are made larger and of better quality than formerly. The weekly production of sulphuric acid of specific gravity 1·85, exclusive of what is used in the manufacture of soda ash, is 700 tons.

Soda.—This is a most important manufacture. Few changes in the principle of manufacture have taken place during the last ten years, the essential points of the original method of Leblanc (1798) being still adhered to. The extent of the manufacture has largely increased since the year 1851. The value of alkali made annually in England is 2,000,000*l.*; of this half is made in South Lancashire and half in the Newcastle district. The following statistics apply to the South Lancashire alkali trade, per week, in 1861:—Common salt decomposed per week, 2600 tons; sulphuric acid used, 3110 tons; hydrochloric acid produced, 3400 tons; soda ash sold per week, 1800 tons; salt cake sold per week, 180 tons; soda crystals ditto, 170 tons; bicarbonate soda ditto, 225 tons; and caustic soda ditto, 90 tons. Since 1852 the alkali trade of South Lancashire had more than tripled. The large quantity now produced was manufactured in about twenty-five works, chiefly situated at St. Helen's, Runcorn Gap, Widnes Dock, near Warrington, the neighbourhood of Bolton, and Newton Heath. None of the patents for improving the manufacture of alkali had changed the process materially. The improvements of detail since 1851 have been the following:—1. Greater attention to economical working in all the branches. 2. The process of lixiviation of black ash is more completely accomplished than formerly by the arrangement of Mr. Shanks. 3. In some works the black ash is now made by machinery. 4. The soda is now in many alkali works packed in casks by machinery. Since 1851, a new branch of the manufacture has been introduced by the preparation of solid caustic soda, which is largely exported to America and other places. The proposition recently made by Kuhlmann for the employment of the alkali waste as a cement is a very old idea, Mr. Deacon, of Widnes, having used it for making floors for twelve years. In conclusion, the report recognised the important additions to our knowledge of the theory of soda manufacture made by Mr. Gossage.

Bleaching Powder.—155 tons of this powder is made in this district. The only remarkable points in the manufacture is an ingenious process of preparing chlorine without the use of binoxide of manganese, patented in 1858 by Mr. Shanks, of St. Helen's, and the regeneration of peroxide of manganese from the waste liquors containing chloride of manganese.

Chlorate of Potash.—From four to five tons of this salt are made weekly in this district, and it is used for match making.

Hyposulphite of Soda.—Three tons weekly are made, and are used by paper makers, photographers, and by bleachers as an antichlor.

Silicate of Soda.—This compound is used as a substitute for cow-dung in calico printing, and by soap manufacturers in place of the resinates formerly in use. About ten tons weekly are produced in this neighbourhood.

Arseniate of Soda.—This salt is used as a substitute for cow-dung in calico printing, for which purpose it is better adapted than the silicate of soda, as it does not so much attach the alumina mordants. Ten or twelve tons are produced weekly in this neighbourhood.

Bichromate of Potash.—There is nothing new in the manufacture of this salt. About fourteen tons are produced weekly in the district.

Prussiates of Potash.—From four to five tons of yellow prussiate of potash and one ton of red prussiate are produced in this district weekly.

Superphosphate of Lime.—The weekly production in this district is 5600 tons.

Alum.—Before 1845 the alum manufactured in this district was confined to a small quantity from pipeclay, our chief supplies being derived from Whitby. By the old process 60 tons of the oolitic shale of Yorkshire was required to produce one ton of potash-alum and one ton of Epsom salts. By Mr. Spence's process 50 tons of shale yield 65 tons of ammonia alum. Mr. Spence employs the shale found underlying the seams of coal in this district. In 1850-51, Mr. Spence made about 20 tons per week. The quantity now made by him amounts to 110 tons. Fully half of the total quantity manufactured in England (300 tons per week) is made by this process.

Protosulphate of Iron.—This salt is manufactured in large quantities in this district, principally for the use of dyers, the amount being about eighty tons per week.

Pyroligneous Acid.—The only improvement introduced into the manufacture of this acid during the last

few years consists in the use of sawdust instead of wood in the process of destructive distillation. The quantity of acid manufactured weekly in Manchester is 12,000 gallons, containing about 4 per cent. of glacial acid. The value of the acid is 3*l.* per ton, whilst that of the tar is 4*l.* to 4*l.* 10s.

Compounds of Tin—Chlorides of Tin.—The quantity of these compounds (estimated as crystallised protochloride of tin) manufactured in this district amounts to about sixteen and a-half tons per week.

Stannate of Soda.—This compound has for some time been extensively used for the purpose of preparing calicoes which are intended to be printed with so-called steam colours.

Sulphate of Baryta.—Of this salt, which is usually sold under the name of *Blanc fix*, about two tons are made in this district by precipitation.

Nitric Acid.—About forty-eight tons of nitrate of soda per week are used in this district for making nitric acid. The salt yields its own weight of acid. Nitric acid is used here for making the nitrates of copper, lead, alumina, and iron, for oxidising tin, for etching, and, latterly, for making aniline.

Oxalic Acid.—One of the most important and interesting of the new manufacturing processes is one for the preparation of oxalic acid, invented and patented by Messrs. Roberts, Dale, and Co., gentlemen to whom we owe a number of highly ingenious and useful practical processes. The quantity of acid manufactured by Messrs. Roberts and Dale amounts to nine tons per week, with capabilities of extension to upwards of fifteen tons. To give an idea of the effect which the introduction of this process has had on the market, it may be mentioned that the selling price at this time is 8d. to 9d. per lb., whereas in 1851 it was 15d. to 16d. per lb. Oxalic acid is used extensively in calico printing, woollen dyeing, woollen printing, silk dyeing with wood colours, in straw bleaching, and for making binoxalate of potash, so-called "salt of lemons."

Starch and Artificial Gums.—About twenty tons of starch and thirty-four tons of gum substitutes, made by roasting farina and other kinds of starch, are produced in this district per week.

Purification of Resin.—Several very interesting and successful processes have lately been patented by Messrs. Hunt and Pochin, of Salford, for the purification of resin. The aim of these gentlemen, who have devoted a large amount of time and attention to this subject, is to produce a bright, nearly colourless, solid, and brittle resin, from the common, dark, and impure commercial article. About sixty tons per week of this clarified resin is now manufactured in this district under this patent.

Organic Colouring Matters.—There are few substances of more importance to the manufacturers of this district than those which are employed in imparting colours to the various fabrics, especially those of cotton, produced here. Of these substances, the majority are derived from the animal or vegetable kingdom. Indeed, with the exception of oxide of iron and chromate of lead, very few mineral substances are at the present time made use of alone by the dyer or printer. The great intensity, beauty, and variety of the dyes which are wholly or in part composed of organic matter, causes them to be preferred, and the increase of skill and knowledge of scientific principles on the part of dyers and printers have also led to their more exclusive employment, when it is stated that the quantity of dye-woods (logwood, peachwood, saffronwood, barwood, fustic, quercitron bark) consumed weekly by the dyers of this district amounts to 300 or 400 tons; that the weekly consumption of the same by printers is about 60 tons; that from 150 to 200 tons are in the same time converted into extracts; that 150 tons per week of madder are used up, exclusive of what is used for garancine, &c., some idea of the magnitude of the interests depending on the employment of the materials may be formed. With the exception of a new method of reducing indigo by means of finely-divided metals, patented by Leonard, we do not suppose that any important improvement has been introduced in connection with this dye-stuff. Of less importance in the art of dyeing is madder, the material with which the most permanent reds, purples, and blacks are produced. The methods which have been proposed for more effectually utilising this important dye-stuff are very numerous indeed, though exceedingly few of them have been found to be of practical value. They may be divided into two classes,—viz., those having for their object to render available the greatest amount of colouring matter, and those which tend to produce more permanent or more beautiful colours. The first object seems to be perfectly attained by converting the madder by the action of acid into garancine. This preparation is becoming more and more extensively used.

Aniline Colours.—The artificial colouring matters from aniline and other bases have of late attracted much attention, and various plans have been devised for producing them. The usual method of obtaining aniline purple, the so-called "mauve," consists in submitting salts of aniline in watery solution to the action of oxidising agents, such as chromates, permanganates, or the peroxides of manganese and lead.

Disinfectants.—The manufacture of disinfectants has become a regular and constant one, and since the inquiries instituted on on the subject by Mr. M'Dougall, of this city, the use of those made in this district has been enormously increased. Mr. M'Dougall manufactures, near Oldham, a disinfecting powder, in which the properties of carbolic and sulphuric acid are taken advantage of. This is used to prevent decomposition in stables, cow-houses, and among accumulations of putrescible matter, and generally for the prevention of decomposition in manures. A liquid is also prepared with carbolic acid and lime-water, which is applied for the purpose of preventing decomposition in sewers, according to the idea entertained by one of us, of purifying whole cities by preventing the generation of gases in sewer water or among accumulations of animal refuse. The liquid is also used to prevent the decomposition of animal matter when it cannot at once be made use of, especially in the case of meat brought to market, or animals that have died in the field. The solution of the powder has also been used, to some extent, in dissecting-rooms, where it immediately destroys any noxious smell, and at once liberates the fingers of the operator from the peculiarly nauseous odour which so often attaches to them. It has also been found useful in the treatment of sores, as well as of dysentery. Mr. M'Dougall has also applied carbolic acid to the destruction of parasitic insects on sheep, and has in many districts entirely driven out the arsenical preparations by the use of this acid united with fatty substances. Sheep dipped in it are not liable to be attacked by tick, even when left for some months among other sheep infected with it. Foot-rot, and other diseases of sheep, are also said to be prevented and cured by its use.

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PHARMACY, TOXICOLOGY, &c.

On Phosphate of Sesquioxide of Iron, by Emile Heydenreich.

For several years various compounds of phosphorus, oxygen and iron, either by themselves dissolved in acids, or combined with some alkaline salts have been used to a considerable extent. Among these, the compound syrup of the phosphates of iron, soda and lime, (the chemical food,) the so-called syrup of superphosphate of iron, and the glyceroles and syrup of hypophosphites of iron have been most generally used. The pyrophosphate of the sesquioxide of iron has also been brought forward by some French chemists, but did not come into use till it was offered by the late M. E. Robiquet, of Paris, in combination with the citrate of ammonia, with which it forms a soluble salt. The extended use which this latter salt has obtained, and the little notice which had been taken of the other compound of phosphoric acid and sesquioxide of iron, led me to make some experiments in this direction. The varied basic character of the phosphate of soda, from which corresponding metallic salts may be usually obtained, would naturally lead one to suppose that similar compounds of the sesquioxide of iron might be obtained by adding to a solution of them solutions of a sesquisalt of iron. This has been verified in the case of the pyrophosphate of iron $2Fe_2O_3,3PO_5$: the reaction being $3\ (2NaO,PO_5) + 2(Fe_2O_33SO_3) = 2\ (Fe_2O_3)\ 3\ PO_5 + 6\ (NaOSO_3)$. According to this, by using the tribasic phosphate of soda, instead of the pyrophosphate, we might expect the reaction to be $3\ (2NaO, HO,PO_5) + 2\ (Fe_2O_33SO_3) = (2Fe_2O_3,3HO,3PO_5) + 6\ (NaO,SO_3)$.

On carefully adding to a solution of tribasic phosphate of soda a solution of tersulphate of sesquioxide of iron to saturation, a bulky white precipitate was obtained; the supernatant liquid was found to be decidedly acid to litmus paper. The precipitate was washed by decantation several times, thrown on a filter, allowed to drain, and finally pressed between bibulous paper. It was afterwards dried on a sand bath till anhydrous, when it was analysed to ascertain its composition; during the washing and drying, the precipitate assumed gradually a yellow tint.

One hundred grains were fused with some carbonate of soda, the mass left after ignition was removed from the crucible, introduced into a dish with some water, and every portion of oxide of iron carefully washed from the crucible; this mixture was allowed to boil, and sufficient acetic acid added to neutralise the excess of carbonate of soda. By this means, all the sesquioxide of iron was precipitated, while the clear liquid contained the phosphate of soda with some acetate of soda. The sesquioxide of iron was collected on a filter, washed and ignited; to the solution of phosphate and acetate of soda a solution of chloride of ammonium, of sulphate of magnesia and of ammonia was added; by this means the double phosphate of magnesia and ammonia was precipitated, which by ignition furnished the pyrophosphate of magnesia, from which the phosphoric acid was calculated. The result of two analyses carefully performed was:—

First Experiment.		Second Experiment.	
Fe_2O_3	52·50	Fe_2O_3	52·00
$2MgO,PO_5$	73·00	$2MgO,PO_5$	74·00

112 parts $2\ MgO,PO_5$ being equal to 72 parts of PO_5, the following is the result:—

First Experiment.			Second Experiment.		
Fe_2O_3	52·50	99·42	Fe_2O_3	52·00	99·57
PO_5	46·92		PO_5	47·57	

These results correspond in composition with the phosphate of sesquioxide of iron $Fe_2O_3PO_5$, mentioned by Will in his "Outlines of Chemical Analysis," and by Dr. Graham, in his "Elements of Chemistry." The reaction, therefore, must be between one equivalent of phosphate of soda, and one of tersulphate of sesquioxide of iron, by which are formed: one eq. phosphate of sesquioxide of iron, two eq. of sulphate of soda, and one of sulphuric acid, which remains in the water: $2\ NaO,HO,PO_5 + Fe_2O_3, 3SO_3 = Fe_2O_3,PO_5 + 2\ (NaO,SO_3) + SO_3, HO$.

Some further experiments were now tried to ascertain its solubility in some solvent, which might render it useful in medicine.

In hydrochloric and nitric acids, it is readily soluble; in phosphoric acid it is insoluble; in citric and tartaric acids it is slightly soluble, more so on the application of heat, forming green solutions. In phosphate of soda it is insoluble, even when heated; in tartrate of ammonia it is slightly soluble, forming a green solution, which, when heated to boiling, is decomposed, forming a gelatinous mass.

Citrate of soda dissolves it in considerable quantity, but the best solvent for it is the neutral citrate of ammonia proposed by M. Robiquet, as a solvent for the pyrophosphate of iron. In this salt it dissolves readily, forming a green solution with a brown shade; when evaporated and spread on glass, and dried, it forms scales of a brownish-green colour, which much resemble those of the citro-ammoniacal pyrophosphate of iron. The dry salt dissolves more rapidly in cold water than the pyrophosphate, and has a pleasant saline taste; a solution of it on the addition of ammonia, remains clear, but turns to a reddish-brown colour, while the addition of a portion of citric acid turns it to a lighter green colour.

100 parts of this salt on examination, were found to lose 10 parts of water, and furnish 23 parts of Fe_2O_3 which correspond to 44 parts of $Fe_2O_3PO_5$, the remaining 46 parts being the citrate of ammonia. We have thus a citro-ammoniacal sesquiphosphate of iron, which is a reliable preparation, containing 23 per cent. of sesquioxide of iron, and possessing decided advantages over most ferruginous preparations, on account of its pleasant taste, while it will prove more active than the citro-ammoniacal pyrophosphate of iron, as it contains more iron. We may, therefore, hope that a fair trial of this new salt by the medical profession will gain for it the place to which its composition would seem to entitle it. —*American Journal of Pharmacy.*

PHYSICAL SCIENCE.

On the Effect of Great Pressures combined with Cold on the Six Non-Condensible Gases,[1] *by Dr.* Andrews.

In this communication the author gave an account of some results already obtained in a research with which he is still occupied on the changes of physical state which occur when the non-condensible gases are exposed to the combined action of great pressures and low temperatures. The gases when compressed were always obtained in the capillary end of thick glass tubes, so that any change they might undergo could be observed. In his earlier experiments the author employed the

[1] Read before the British Association.

elastic force of the gases evolved in the electrolysis of water as the compressing agent, and in this way he actually succeeded in reducing oxygen gas to $\frac{1}{300}$th of its volume at the ordinary pressure of the atmosphere. He afterwards succeeded in effecting the same object by mechanical means, and exhibited to the Section an apparatus by means of which he had been able to apply pressures, which were only limited by the capability of the capillary glass tubes to resist them; and while thus compressed the gases were exposed to the cold attained by the carbonic acid and ether bath. Atmospheric air was compressed by pressure alone to $\frac{1}{871}$ of its original volume, and by the united action of pressure and a cold of — 106° F. to $\frac{1}{675}$th; in which state its density was little inferior to that of water. Oxygen gas was reduced by pressure to $\frac{1}{324}$th of its volume, and by pressure and cold to $\frac{1}{554}$th; hydrogen by the united action of cold and pressure to $\frac{1}{500}$th; carbonic oxide by pressure to $\frac{1}{278}$th, by pressure and cold to $\frac{1}{278}$th; nitric oxide, by pressure to $\frac{1}{310}$th, by pressure and a cold of — 160° F. to $\frac{1}{680}$th. None of the gases exhibited any appearance of liquefaction, even in these high states of condensation. The amount of contraction was nearly proportional to the force employed, till the gases were reduced to from about $\frac{1}{300}$th to $\frac{1}{350}$th of their volume; but, beyond that point, they underwent little further diminution of volume from increase of pressure. Hydrogen and carbonic oxide appear to resist the action of pressure better than oxygen or nitric oxide.

PROCEEDINGS OF SOCIETIES.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Section B.—Chemical Science.

The President, Dr. W. A. Miller, F.R.S., &c., Professor of Chemistry, King's College, delivered the opening address.

The President said that, in the home of Dalton, in the focus of applied chemistry, very few words would be necessary. They could not but remember that, on the last occasion, when the meeting of the British Association was held in Manchester, that illustrious philosopher was still amongst them; and he trusted that the same spirit which actuated Dalton still remained in Manchester to enlighten his native country. Without saying more by way of introduction, he would call their attention to one or two points of progress during the past year. In calling attention to these subjects, he must necessarily refer to debatable ground in science,—but it was in debatable land that progress was necessarily made. He would only touch upon two or three practical applications of chemistry, and two or three theoretical ideas since they last met. The Professor then alluded to the new methods of preparing oxygen and hydrogen, proposed by Deville, which admit of application on such a scale as to allow of the generation of oxygen for manufacturing purposes, and the employment of the oxyhydrogen blast, as a source of heat, in metallurgical operations. The novelty in the preparation of oxygen consists in decomposing by heat the vapour of sulphuric acid, and by a further process, storing up the oxygen in gasholders. The preparation of hydrogen required more care. The metallurgy of platinum had already experienced a remarkable modification, owing to the application of the intense but manageable source of heat obtained by the combustion of these gases.

In connection with oxygen might be mentioned a singular circumstance regarding ozone, which, according to the observation of Schrötter, had been found in a peculiar species of fluor spar, from Wolsendorf, which, when rubbed or broken, emitted a peculiar odour of ozone.

The active chemist Deville, in following his researches, had discovered a variety of means of obtaining, artificially, crystallised minerals of great regularity and beauty. The methods adopted were chiefly by heating the amorphous substances in a slow current of some gas, such as hydrochloric acid, which was not an unfrequent natural product in volcanic districts.

No discovery, however, had made a greater impression upon the popular mind than that of the remarkable alkaline metals, cæsium and rubidium, by Kirchhoff and Bunsen. These eminent men, in investigating the appearances presented by flames coloured by various metallic salts when analysed by the prism, were led, from the appearance of certain bright lines in the spectra, produced whilst they were examining a saline residuum from the waters of the Durchheim spring, to infer the existence of a substance hitherto unknown. It was found that cæsium was present in such minute quantity that a ton of that water, which was the most abundant source of cæsium yet known, contained only three grains of its chloride. Taking into account the minuteness of its quantity, and its striking resemblance to potassium, it was not too much to say that the discovery of cæsium would have been impossible by any other known method than that which was actually employed. The other metal, rubidium, was somewhat more plentiful; but rubidia also so closely resembled potash, that it would not have been discovered but for the peculiarity of its spectrum.

Referring to the revision of the atomic weights of sulphur, silver, nitrogen, potassium, sodium, and lead by Stas, Professor Miller said that chemist had come to the conclusion that it was not proved that the elementary bodies were multiples of the unit of hydrogen, and in opposition to the opinion of Dumas he had pronounced the law of Prout as imaginary.

Every chemist would read with interest the paper by Graham upon the application of liquid diffusion to analysis. The remarkable conclusion to which the author arrived was that the process of diffusion separated all substances into one or other of two classes, which he distinguished as crystalloids and colloids.

The rapid improvement in the methods of analysis, though not admitting on that occasion of detailed mention, must not be overlooked. A variety of bodies, formerly supposed to be of rare occurrence, were now found in minute quantities, unexpectedly, but widely diffused. The discovery of these small substances was by no means unimportant, for they might aid in solving problems of great interest.

Glancing only for a moment at the important practical subject of the formation of steel, Professor Miller referred to the activity displayed in the pursuit of the organic department of Chemical Science, remarking upon two lines of research as important from their theoretical bearings, — namely, the investigation of polyatomic compounds, and the process of oxidation and of reduction, applied by various chemists, and by Kolbe in particular, to the investigation of the organic acids. The labours of Hofmann upon the polyatomic bases showed completely the principle upon which these bodies might be formed, and he had been enabled to group an unlimited number of atoms of ammonia into one compound molecule. Great progress had also been made in our knowledge of the relations of the organic acids. In conclusion, the President said that Drs. Schunck, Roscoe, and Smith had prepared a Report on the Manufactures of the South Lancashire District, and perhaps few were aware of the large extent to which the science was applied and used in the neighbourhood of Manchester.

In the evening the President gave a lecture in the Concert Hall on "*The New Method of Spectrum Analysis.*"

Professor Miller said that the subject which the

Council of the Association had desired him to bring before the meeting was one which, amongst the scientific questions of the day, had attracted as large a share of popular attention as any that could be named. It appealed to the imagination so powerfully,—it revealed to us matters of investigation much in the same way as the telescope made known to us what was passing in distant worlds, bringing before us not only those particular changes which appeared to be going on in the bodies which compose our solar system, but it appeared, also, further to reveal to us something of the nature of those distant solar orbs which stud the firmament. Not only, however, did it make known those wonders at a distance, but, like the microscope, it revealed to us also quantities of substances so minute that they would defy any other mode of investigation; it made known to us bodies which not only would defy, but up to the present time had defied, all the sources of analysis and chemical skill. He thought he should best discharge the duty which devolved upon him if he endeavoured to bring before them in an exceedingly brief manner the successive steps by which this discovery had been made. Like all other great discoveries, it was not the work of one individual. It was a work in which, he was proud to say, their own countrymen had taken a prominent part, and many of the members of the British Association had laid the foundations of our knowledge of this point. Newton communicated the first information upon this subject in 1701. We knew nothing of the solar spectrum till Newton revealed it in his great work on Optics in that year, his researches having occupied him many years previously. He would first bring before the audience the spectrum as seen by Newton (not that Newton had the means of producing that artificial light which on that occasion he should employ), gradually bringing them up to the present time. The spectrum was perhaps the most glorious sight the eye could behold.

(Professor Miller then directed a beam of white light upon the wall from an electric lamp, and afterwards directed it, through a prism, to a screen on the platform prepared for the purpose. The beautiful prismatic colours on the screen drew forth indications of approbation from the audience.)

The Professor then went on to say that in the solar spectrum dark lines or bands were discovered by Wollaston in 1801; and the distinguished German philosopher, Fraunhofer, discovered dark lines crossing the spectrum at right angles to its length. Those lines were seen whatever was the material used in the prisms. He would for a moment anticipate his subject by thirty years, in order to show a photographed spectrum on a surface of collodion. This image, it would be seen, was not continuous, but was intersected by bands more or less bright. This he showed in order that his audience might understand what he meant when he referred to Fraunhofer's black lines in the solar spectrum, upon the nature of which much speculation had been exercised. The point next to remember was that other lights than that of the sun also exhibited these lines. For instance, if a solid substance were heated till it gave out light, as all solid bodies would when sufficiently heated, these solid bodies—whether the ball of lime in the oxy-hydrogen light, or the charcoal in the electric light—exhibited broken spectrum, being crossed by bright lines. This led him to several distinct lines of research followed since Fraunhofer. First, the lines in the solar spectra, which he might call cosmical. Next, lines produced by the process of absorption. For the discovery of these lines we were indebted to one of our most illustrious philosophers, who was with them on that occasion—Sir David Brewster. (Applause.) Then there were a series of lights produced by coloured flames. Lastly, there was a series of lines for the knowledge of which they were mostly indebted to Professor Wheatstone—(renewed applause)—the lines produced by the electric spark. Wollaston and Fraunhofer noticed that the electric spark produced spectrum, but they went no further. Professor Wheatstone had, however, done so. He had no opportunity of presenting to the audience any of the cosmical lines beyond that he had already shown in the photograph. Sir David Brewster was the first person to throw a light on these lines. He observed that under certain circumstances the sun's rays were absorbed. It appeared certain that particular rays were deepened by the absorbing action of the earth's atmosphere. Then came the beautiful discovery of Becquerell's, in 1842, by which it was made known that there was the same interruption, or black lines, in phosphorogenic rays; and Stokes a few years afterwards showed that the rays which produced florescence were interrupted precisely in the same way. But no one had satisfactorily explained the cause of these lines.

He would now lead his audience a second step, for which they were also indebted to Sir David Brewster. He discovered that the dark orange-coloured gas, nitric oxide, had a very remarkable absorptive power upon the sun's rays. This brownish-red gas, placed in a ray of light, and afterwards examined by the prism, showed a series of black bands much more distinctly than those occurring in the sun's light. The moment he put this gas into the course of the ray it produced the black lines. A good many other gases had similar effects. The next point of interest was observed by M. Foucault, who found that by sending the sun's rays through the electric light, we got a black band where the electric light showed a bright one. This led to the discovery which formed the subject of the present discourse. The next step was the discovery of the spectra of coloured flames. In 1822, Sir John Herschel made a series of observations upon coloured lights; and it appeared to Talbot that these observations might be turned to account for chemical analysis. Professor Miller then showed by experiment the observations made by Mr. Talbot upon lithium and strontium, the flames of which were so closely allied in colour that when viewed by the unaided eye but little could be seen to distinguish them one from the other; but the moment they were viewed through the prism there was a marked and striking difference in the bands. Mr. Talbot pointed out that soda and potash gave out very peculiar spectra. It did not matter what preparation of potash was used, the result was the same. In the case of the spectra of the alkaline earths, the lines were very numerous. A map of the spectra [here pointed to] was one published by Bunsen and Kirchhoff; another, going much more into detail, had been published by himself. Passing on to another point of great importance, Mr. Swan, he said, was the first person who endeavoured to estimate the delicacy of these reactions, and he showed that so minute a quantity as the one two millionth and a-half part of a grain of a salt of sodium could be detected by the colour of its flame. Other points also were investigated by Mr. Swan.

The next step was with reference to the spectra of the electric light; and here Mr. Wheatstone gave the first impulse to discovery. In the year 1835, he showed, at Dublin, a map of various spectra produced by the electric sparks passed between different metals, and he discovered the very important principle that each metal had its own peculiar spark, alike whether the electricity employed were voltaic, magnetic, or from the common electrical machine. He further showed these phenomena were not due to the burning of the metals, for he performed his experiments in an air-exhausted vessel, and he put carbonic acid in the vessel and still found the same light. He also examined metals in their melted state, and the spectra of one or two of these the lecturer here showed. The barium spectrum having been exhibited parenthetically, Professor Miller went on to display Mr. Wheatstone's spectra of lead and tin; and he stated that Mr. Wheatstone's investigations had led to the offer of a prize for further investigation, Mr. Wheatstone having been at that time engaged with his electric telegraph. This prize was won by M. Masson,

who published from 1851 to 1855 some important papers on this matter, with engravings of the spectra, giving much more complicated lines than those given by Mr. Wheatstone. Having displayed the spectrum of silver, the learned lecturer proceeded to refer to further experiments made by an American discoverer, and others whom he named. Amongst these were a number of curious observations on the spectra of gases in tubes first filled with these gases, and then as much as possible exhausted. On the table in front of the platform stood an apparatus, consisting mainly of two such tubes, the one containing hydrogen, the other nitrogen, both in imponderable quantities. Electric light passed through these tubes gave, in the one case, a vivid red; in the other, a brilliant blue. It was also found that if two pieces of wire having on them the least trace of lime, or baryta, or soda, were subjected to the electric spark passing between them, the characteristic spectra of those metals were produced. Nobody up to that time had explained the relation of these different facts with the other.

M. Kirchhoff, and simultaneously, Mr. Stewart, investigated the nature of radiant heat, the vibration produced by different degrees of temperature; and both concluded that when a substance was heated it gave out a certain set of rays, which, when cold, it absorbed; or *vice versâ*. Having exhibited the light of sodium under the two conditions, to show the contrast, next Professor Miller remarked that the black line in the spectrum before them was the key-note to the whole of Kirchhoff's explanation. The light absorbed there was not lost; it was radiated in all directions instead of being cast on the screen. Kirchhoff proved by theoretical deductions that the dark bands in the solar spectrum were the reverse of the bright bands, and found he could reverse the bright bands, not only of sodium, but of lithium, potassium, barium, and strontium, by putting their flames in the course of the sun's rays. Turning to stellar matters, Kirchhoff had said with great probability that the spectra of Fraunhofer were merely the bright lines which we should see if there were not an intensely heated body in the atmosphere of the sun producing these dark lines. His opinion was that in the luminous atmosphere of the sun, vapours of various metals were present; and that the solid body of the sun behind the luminous atmosphere, emitting rays of all degrees of refrangibility, caused these lines to be observed. Kirchhoff had arranged an extremely sensitive apparatus, by means of which he had been enabled to magnify the solar spectrum in such a way that he could get a spectrum eighteen feet in length, and view every part of it with a microscope. Sir David Brewster and Dr. Gladstone had recently made known the existence of at least two thousand black lines in the solar spectrum, but Kirchhoff estimated them as very much more numerous. Showing them a map of the solar spectrum, Professor Miller said that amongst the lines thus exhibited were a large number corresponding exactly to the lines produced by known metals; and he pointed to and described the drawing of apparatus whereby at once the lines of the solar spectrum could be seen simultaneously and compared with the lines characteristic of mundane metals. Every star had its own series of lines, some of them seeming to show sodium. The sun appeared to contain sodium, potassium, iron, chromium, nickel, and magnesium.

Bunsen, in observing the residue of the water of a certain spring, found spectrum lines which he had never seen before, and supposed them to be due to the presence of an unknown metal, which he afterwards was able to isolate, finding that three grains (only) of it were extractable from a ton of the water. From the beautiful blue lines in the spectrum produced by this metal he named it Cæsium. By the kindness of Professor Bunsen, who had complied with Professor Roscoe's request for a specimen, the lecturer was enabled to exhibit the spectrum lines of this new metal; and Professor Roscoe had also supplied him with a sample of another new metal thus discovered, and named Rubidium, the spectrum of which he also threw on the screen.

Dr. Robinson said he had been deputed to propose a vote of thanks to Professor Miller for the lucid and instructive exposition which he had given of one of the most remarkable discoveries of modern times. As a humble labourer in the same field, he had come forward to express his sense of the high privilege which he had shared with others in hearing those great and magnificent truths so splendidly explained. Familiar as he was himself, from his own researches, with many of those truths, he had never seen them so fully and so beautifully illustrated as they had been that evening. What a wonderful triumph of human intellect it was even to measure the dimensions of the sun; to pass over that vast field that separated him from us, and to weigh that great orb in the balance and to say that it was of such a specific gravity—what a wonderful triumph it was! By the marvellous powers of sight, those powers which linked together for us distant portions of space, it might be conceived that we could pass over that enormous void; but what a triumph it was to say that we could travel there with the understanding—to say that the sun was of such a magnitude, of such a gravity, contained such elements, was composed of such substances, and was a part of our system bound to us by a community of elements! (Hear.) They had that night seen exhibited on the screen those luminous bands which indicated that in the atmosphere of the sun there existed the metals magnesium, sodium, chromium, cobalt, and iron. These were the metals which they knew from other facts pervaded the planetary system. They were found on earth in those mysterious strangers which, under the name of aërolites, came down from the planetary space and gave us indications of the common links which bound us together with the other bodies of our system. (Applause.) He concluded by proposing the resolution.

Mr. Hopkins, the newly-appointed Secretary to the Association, seconded the resolution, which was carried with acclamation, and the interesting proceedings terminated about ten o'clock.

NOTICES OF PATENTS.

Improvements in the Treatment of Vegetable Substances, and in the Preparation of Beverages Therefrom. J. H. Johnson. A Communication. (Not proceeded with.)

The inventor proposes to subject to a kind of desiccating process the leaves, shoots, and other portions of trees, shrubs, and plants, containing tannin or other bitter vegetable principle. When dried, these are to be coarsely pulverized, and used either alone or in admixture with tea, coffee, or any similar substance for the preparation of drinks by infusion or decoction.

In reference to this specification, it is almost needless to remark that, besides having a tolerably comprehensive aim, the novelty of the process is questionable, since the treatment directed is precisely similar to that by which the tea-plant has always been prepared. The production of counterfeit tea from sloe leaves, Paraguay tea, and even the old well-known doses of camomile and senna might be advanced as arguments contradictory to the novelty of the suggestion. For ourselves, we should much prefer to accept the cup of tea prepared as a wholesome beverage without the admixture of any sort of medicinal nastiness which might originate with a proposal such as that under discussion—a proposal which fortunately has in the present instance failed in taking practical effect.

Certain Applications of Chapapote and its Products. J. J. De Arrieta.

This invention relates to the employment, for various use-

ful purposes, of a certain natural matter called, in Cuba, *chapapote*, whether in its concrete, viscous, or more or less fluid condition, and whether alone or combined with other substances. It may be applied as a coating to wood, metal, stone, paper, leather, textile fabrics, fibrous materials, and to a variety of other substances, to all of which it communicates an additional degree of protection not only from wear and tear, and the ravages of insects, but from the destructive action of damp and oxidising influences generally. It may also be employed as a waterproofing material; as an impervious varnish or coating in the construction of air-tight vessels; it serves to strengthen and likewise to ornament wood and other porous and fibrous materials. The chapapote is for any of these purposes, applied in its natural condition or in combination with gums, resins, wax, and fatty matters, essential oils, including those produced by the destructive distillation of the substance itself; with gutta percha and India-rubber, spirit and naphtha, hydrocarbons, varnishes, or conjointly with any one of the numerous classes of mineral substances, individually specified. Also with agents for resisting combustion, and other agents and matters.

The comprehensive nature of the specification, of which the above is but an outline sketch, reminds us of the early patents relating to the applications of gutta percha. The significant finale, "and other agents and matters," surely leaves nothing out of enumeration. The West Indian natural product here described, seems to bear a general resemblance both to caoutchouc and to gutta percha, and apparently to be capable of similar application.

Mounting of Tablets or Show-bills, &c. B. G. George, Hatton Garden.

The object of the patentee is to produce, at a small cost, an embossed show-card or tablet that will retain its shape notwithstanding the variable temperature and humidity of the atmosphere. By means of a metal die and a counter-die of the pattern or device required, and a printing surface also of the same pattern, the inventor takes first a printed impression upon paper or card; this, thoroughly wetted, is then laid face downwards on the embossing die, and the counter-die then brought down with pressure upon the back of the sheet produces a representation which may be either in relief or *intaglio* at pleasure. A plaster-cast is also prepared from one or other of these dies, which is intended to be used as a backing to preserve the shape of the card, the surfaces being permanently fastened by any suitable adhesive composition, and, if needful, again dried under pressure to ensure perfect contact and accuracy of form.

The mode of proceeding thus minutely described, displays certainly a high degree of ingenuity, and would be calculated to produce a kind of advertising card well adapted for exhibition in our treacherous climate. The additional precautions of varnishing the face of the tablet and of closing, by an after treatment, the pores of the plaster, would no doubt further contribute to the permanent character of the result.

Improvements in the Manufacture of Plate Glass, and in Furnaces employed therein. R. W. Swinburne, South Shields, Durham.

The first improvement refers to the construction of furnaces for melting or firing the materials for the manufacture of plate glass, which furnaces are constructed after the fashion of reverberatory furnaces; but the fire is so placed that the crucible or melting-pot is entirely surrounded with flame. The second improvement consists in a new mode of casting plate glass. For this purpose the patentee constructs a furnace capable of receiving the large pots usually employed in the manufacture of crown or sheet glass. He places these melting-pots at such a distance from each other as will admit one or more cisterns or movable pots to stand between them, and at such an elevation that the brims or edges of all the pots in the furnace are at the same level. The "metal" or melted glass is ladled out of the larger pots into those adjoining, which when filled are removed to the casting-table, whereon their contents are thrown to be rolled into plate glass. The mode of removing them and emptying their contents on the casting-table, is the particular object of this part of the invention. Without entering further into the mechanical details of the specification, it is sufficient to state that the crane or lifting apparatus usually placed above the casting-table is dispensed with, and that cutters or knives for trimming off the edges of the newly-cast plate are superadded to the ordinary equipment.

Improvements in the Manufacture of Manure when Urine is Used. H. Phillips and J. Banneir.

In manufacturing manure when employing urine, it is first collected and stored in vessels, where it is allowed to become decomposed. The construction of these collecting vessels is described as having traps with water-joints, and all the air-outlets provided with an arrangement for holding charcoal or other deodorising material, so that no offensive vapours can make their escape into the atmosphere. It is proposed to convert the stale urine into manure by saturating therein any dry vegetable matter, by preference the ground spent bark of tanners; the materials are allowed to stand in a heap for some weeks, then spread out to dry, and again moistened with the same liquid. This treatment is repeated until the fertilising materials are sufficiently concentrated, and towards the end of the operation it is preferred to employ a small proportion of sulphuric acid in admixture to prevent the escape of ammonia.

There is no doubt that a very valuable manure would be furnished by the process here described; but whether the economy of the process will enable it to compete with other simple means frequently practised on the farm, is a little questionable. The priority of the claim for the employment of charcoal in the air-passages is undoubtedly due to Dr. Stenhouse.

Colouring Matters for Dyeing, &c. M. J. Stark, Norwich.

This invention refers to the production of purple colouring matters from aniline, toluidine, cumidine, or any other analogous substances. The patentee converts either of these bases, or any mixture of them, into an organic salt by the addition of an acid, the use of hydrochloric alone, or with nitric acid being preferred. The saline product resulting from the admixture of acid and base is to be diluted with about an equal bulk of water, and gradually mixed with any soluble ferri-cyanide, that of potassium being used by preference. The proportion in which this latter salt is recommended to be employed, amounts to a weight equal to that of the aniline originally taken. After the whole of the acid solution of aniline has been added, the temperature of the liquid is raised to ebullition, and maintained at a boiling heat for a period of one or more hours, varying with the bulk of material operated upon. When the whole has been sufficiently boiled it is allowed to cool, and the greyish-blue precipitate which will have formed separated from the liquid by filtration or subsidence and decantation. This is collected and washed, and while still moist boiled for an hour or so with tartaric or other acid—one part of crystallised tartaric acid to two parts of water—which treatment will have the effect of extracting the brilliant colouring matter from the bulky precipitate; but for the perfect removal of the same, this boiling with acid may require to be repeated. The filtered solution may at once be employed for dyeing purposes, but the inventor prefers to treat it as follows:—When cold it is mixed with ammonia (or with any alkali or alkaline earth) in slight excess by which the purple

dye is precipated and may be collected by filtration. It should finally be re-dissolved in alcohol or methylated spirit to furnish a dye of a very permanent character, and of a brilliant purple colour, to which the inventor has given the name "chyraline."

This process differs from that originally described by the discoverer, Mr. Perkin, only in respect to the substitution of *ferri-cyanide* for *bichromate* of potassium. Both are oxidising agents, precisely similar in their behaviour as regards their action upon organic bases—thus, in the colour-test for strychnine, these salts are, in conjunction with sulphuric acid, employed almost indiscriminately—so will the products of these patented processes be identical, whether "mauve" or "chyraline" be the name under which the purple dye is introduced to the public.

Grants of Provisional Protection for Six Months.

2010. John Lancaster, Princes Street, Bedford Row, London, "A new method of producing sand."

2024. Edmund Edwards, Beaufort Street, Strand, London, "Improvements in machinery or apparatus for separating mineral ores, coal, and other substances from impurities."—Petitions recorded August 14, 1861.

2034. Francis Allen Kain, Redhill, Reigate, Surrey, "An improved manufacture of artificial stone or earthenware applicable for bricks, tiles, retorts, railway sleepers, and other articles."

2059. William Gossage, Widnes, Lancashire, "Improvements in the manufacture of certain kinds of soap and in the construction of apparatus to be used in such manufacture."

2096. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the preparation of pulp for paper."—A communication from Mademoiselle Jeanne Française Marie de Cassan and Monsieur Jean Baptiste Meyer, Paris.

2100. Louis Marino Casella, Hatton Garden, London, "Improvements in mercurial thermometers.

Notices to Proceed.

1039. Samuel Fox, Stockbridge Works, Deepcar, near Sheffield, Yorkshire, "Improvements in hardening and tempering steel."

1055. John Marshall, Liverpool Road, London, "Improvements in preventing the fracture of metals from crystallisation."—Petitions recorded April 26, 1861.

1079. Jacques Meyer, Berlin, Prussia, "Certain new chemical combinations, and for the application thereof to fixing aniline and pigment colours in printing and dyeing, to tanning, waterproofing, and other industrial purposes." A communication from Dr. Francis Leopold Sonnenschein, Berlin, Prussia."—Petitions recorded April 30, 1861.

1095. John Charles Wilson, Bucklersbury, London, "Improvements in machinery or apparatus for the manufacture of sugar."

1646. John Cass Smart and Adam Aitchison, Scarborough, Yorkshire, "Improvements in the manufacture of charcoal."—Petition recorded June 27, 1861.

1726. Alfred Noble, Bristol, "Improvements in obtaining products from alkali waste and gas lime refuse."—Petition recorded July 6, 1861.

1817. Robert Mushet, Coleford, Gloucestershire, "Improvements in the manufacture of cast steel."—Petition recorded July 19, 1861.

2059. William Gossage, Widnes, Lancashire, "Improvements in the manufacture of certain kinds of soap, and in the construction of apparatus to be used in such manufacture."—Petition recorded August 19, 1861.

A Solution of Starch for Volumetric Analysis is prepared by Dr. F. Mohr, by trituration, with concentrated chloride of zinc, and diluting with water; the solution is not clear, but after precipitating the zinc by carbonate of soda, the filtrate is transparent.—*Ann. d. Chem. und Ph.* xxxix. 211—213.

CORRESPONDENCE.

New Source of Rubidium and Cæsium.

To the Editor of the Chemical News.

Sir,—The enclosed letter from Professor Bunsen may be interesting to your readers, as it shows in what way lithium is associated with the two new alkali metals in its chief sources, lepidolite and triphylline.—I am, &c.

W. Stevens. Squire.

37, Acacia Road, N.W.

Dear Dr. Squire,—I only returned last week from Switzerland, and, unfortunately, with inflammation of the eyes, which has confined me to a dark room for the last eight days. This is the reason I have not written sooner to thank you for the triphylline residues which you kindly brought me, and to express my regret that I was, by my absence from home, deprived of the pleasure of seeing you when in Heidelberg. The residues are comparatively very rich in rubidium and cæsium, and contain much more of the latter than of the former, while the residues from lepidolite contain scarcely any cæsium. To judge from the reaction in the spectrum apparatus, we ought to be able to prepare eight or ten grammes of chloride of cæsium from the whole quantity. Thanking you once more for your kind gift, by which you have put into my possession so rich a source of cæsium,—Believe me yours very truly,

R. W. Bunsen.

Heidelberg, September 10.

Printing Prussian Blue.

To the Editor of the Chemical News.

Sir,—Some time last year I was annoyed to find that, in endeavouring to prepare flame-proof fabrics by the use of a mixture of starch and sulphate of ammonia, the condemnation of the use of this salt by Versman and Oppenheim was not undeserved, as the iron is acted upon in the subsequent stages of the laundry process. This is not unaccountable; for I have before observed that copper foil, in presence of air heated with sulphate of ammonia, liberates ammonia. Iron does the same. I have seen a beautiful crystalline compound, white, and in appearance like citric acid, containing iron and ammonia and sulphuric acid. Now, I have found that by printing on to cloth, in any pattern, sulphate of ammonia and yellow prussiate of potash it will remain white for any length of time; but upon passing the piece over a hot surface of iron, the printed parts instantly strike blue, especially if slightly damped. Would not this be available in printing blues and browns on the large scale by iron and copper rollers?

I am, &c. John S. Blockey.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

The Chlorides and Bromides of Tungsten.—C. Blomstrand describes (*Journ. für prakt. Chem.*, Bd. lxxxii. s. 408) four chlorine compounds of tungsten.

1. *Perchloride of Tungsten*, WCl_6, remains as the final product of the action of chlorine (when no oxygen is present) on metallic tungsten or the sulphide, at a strong heat. The vapour is orange coloured. It crystallizes indistinctly, decrepitates on cooling, and is slowly decomposed by water forming the coloured tungstic acid.

2. *Chloride of Perchloride of Tungsten*, W_2Cl_5 or ($WCl_2 + WCl_3$) formed probably in small quantity in the preparation of the foregoing compound, and obtained pure by the reduction of that salt with hydrogen. Dark grey like the above, vapour greenish yellow, fuses with difficulty, crystallizes easily, cools without decrepitating, is quickly

decomposed by water with the separation of the blue oxide of tungsten.

3. *Monoxychloride of Tungsten*, WCl_2O_4 or ($2\,WCl_3 + WO_3$) is best prepared by gently heating the sulphide of tungsten made in the wet way in chlorine. It is of a beautiful red colour, and crystallizes in transparent needles. It is very fusible; the vapour is orange-coloured. Decomposes in water like the former.

4. *Binoxychloride of Tungsten*, WCl_2O, or ($WCl_3 + 2WO_3$) is formed simultaneously with 1 and 3 in the first stage of the action of chlorine on pure oxide of tungsten. It has a yellowish colour, is vapourised into a colourless gas without fusing, crystallizes in scales, and is decomposed, like the others, by water.

The author also describes three bromides:—

1. *Bromide of Perbromide of Tungsten*, W_2Br_5, formed by the direct action of bromine on metallic tungsten. It is black, gives dark purple brown vapours, crystallizes easily in distinct needles, decomposes in water, depositing the black oxide.

2. *Monoxybromide of Tungsten*, WBr_2O, or ($2\,WBr_3 + WO_3$) formed under the same circumstances as the corresponding chlorine compound. Colour resembles that of the preceding salt, but is lighter, vapours brown red, usually crystallizes in perfect needles, decomposes in water.

3. *Binoxychloride of Tungsten*, also formed like the corresponding chlorine compound. Ordinarily brass or mosaic gold coloured crystalline scales, infusible, decomposing in water.

The author believes in the existence of a *perbromide*, WBr_3, but thinks Bonnet's oxybromide—$WBr_5 + W_2O_5$—apocryphal.

II. ORGANIC CHEMISTRY.

Introduction of Hydrogen into Organic Compounds.—Zinin (*Bulletin de St. Petersburg*, T. iii. p. 529), and Kolbe (*Annal. der Chem. und Pharm.* Bd. cxviii. s. 122), have experimented on the direct addition of hydrogen to organic compounds. The latter digested a hot saturated solution of benzoic acid and a little hydrochloric acid with sodium amalgam, and in this way obtained bitter almond oil, another oil which becomes a crystalline solid on cooling, and a volatile acid. When the action takes place in an alkaline solution, the changes are different. No bitter almond oil is obtained nor the crystalline oil, but more of the new acid is formed, which Kolbe intends to investigate further.

Zinin continues the researches on benzile, some account of which was given at page 223 of our last volume. He there showed that benzile might be converted into benzoïn by the direct addition of hydrogen. He now shows that by continuing the action longer, new bodies may be formed containing more hydrogen than benzoïn. The author made a boiling solution of one part benzoïn and three or four parts alcohol of 75 per cent., and to this he added one part of strong alcohol saturated with hydrochloric acid gas, and then half a part of finely-granulated zinc was slowly introduced into the mixture. As soon as the violent reaction ceased, another half a part of the alcoholic solution of hydrochloric acid gas was added, and the mixture boiled down to half. It was then poured off from the undissolved zinc and mixed with water, whereupon an oily body separated which soon cooled into a crystalline mass which was purified by re-crystallization from alcohol. It was then obtained in rhombic tables, which fused at 55°. This new body is more hydrogenated than benzoïn; but the elementary analysis, the author says, presents unusual difficulties. By the action of nitric acid and of bromine on this new body, other crystallizable bodies are formed.

Bitter almond oil dissolved in the alcoholic solution of hydrochloric acid and boiled with zinc, forms a thick oily body which sticks to the sides of the flask, and on cooling becomes solid and resinous. It is freely soluble in ether, and from the solution part crystallizes out, the remainder separates as an oily mass, in which, after a time, other crystals form.

MISCELLANEOUS.

Smelting Spanish Iron Ore in England.—Mr. Morrison, of Ferryhill, has just imported a cargo of very fine quality iron ore from Santander, which is said to have proved very valuable in the South Wales district for improving the quality of iron produced from British ores. The ore exists in enormous deposits within a quarter of a mile from the river, and is worked most inexpensively. Many hundreds of tons per week could easily be raised and shipped, and whilst the present low freight continues a profit can be realised upon shipment either to Wales or the North.—*Mining Journal.*

The Oil Wells of Pennsylvania—Curious Spouting Phenomena.—A correspondent of the *United States Railroad and Mining Register*, writing from Oil Creek, Pa., gives some very interesting information respecting the oil wells and the nature of the rocks in which they are found. He states that the yield from the wells has greatly decreased, and that the oil well region, for practical working, is of very limited extent. He says:—"Along the banks of the Allegheny, for five or six miles above the mouth of Oil Creek, and at a point some three miles below Franklin, operations have been and continue quite successful, so that these may be counted among the reliable sources of supply. Beyond them, the Allegheny river, for profitable oil production may be considered *dry*." The oil in most of the wells is found in a series of sandstone rocks, which are usually met with at about 190 feet below the surface, and the pockets of oil are located in fractures. In many borings, no oil has been found; while in adjacent drillings, which have been pierced into vertical fractures, large quantities have been obtained. Many wells which once yielded twenty barrels per day are now dry. The usual depth of working the wells is 200 feet, but the oil is obtained at various depths. After drilling down 200 feet, a mass of shales 100 feet in thickness is encountered, in which no oil of any account is obtained. At about 325 feet in depth, there is about 40 feet of white sandstone, near the top of which "spouting wells" are found. This is the second oil yielding strata. After passing through this rock, another mass of shales and fire clay is met with; and at 450 feet in depth, another stratum of sandstone, which forms the third oil-bearing series. Here the "big spouting wells" are found, the yield of which is from ten to two hundred barrels per day. These spouting wells are curiosities; they are genuine land whales, and twice as oily as their rival sea monsters. The spouting is caused by compressed gas, and the flow is periodical. One well will flow for five minutes with intervals of ten. Its neighbour will flow once an hour; while one flows four times, and another six times, in twenty-four hours. Again, the ten-minute well will change to a regular flow of three or four hours' duration. Most of them grow gradually less vigorous, and diminish in yield until they finally cease; but some of them stop suddenly.

ANSWERS TO CORRESPONDENTS.

G. F. Rodwell.—Received, with thanks.

R. S.—See Dr. Roscoe's paper read before the British Association, reported in the present number.

John S. Blockey.—The patents referred to in the Chemical News for September 7 (page 135), bear the following dates and numbers:—C. H. G. Williams, No. 67, dated January 10, 1861; C. A. Girard, No. 97, dated January 12, 1861; V. Hall, No. 101, dated January 14, 1861. With a view to identification, we propose, in future, to furnish these particulars in connection with every patent coming under our notice.

THE CHEMICAL NEWS.

VOL. IV. No. 95.—September 28, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Presence of Nitrates in Mineral Waters, and on the Production of Saltpetre, by R. HAINES, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

(Continued from page 155.)

THE existence of nitrates in mineral waters is no new discovery. Berzelius, writing in 1826, gives directions for the estimation of the nitric acid in them;[1] and H. Rose's "Manual of Analytical Chemistry," published in 1830, describes the method for estimating it, which I attempted to apply.[2] The proportion, however, that is present is usually very minute indeed, and in the greater number of published analyses it has escaped detection altogether. I have collected together, in the following table, all the analyses I can find on record in which nitric acid occurred in any notable quantity. The number is very small. The quantity of water referred to has been reduced, for the sake of comparison, to the British imperial pint.

Locality.	Saidschütz[3] in ?	Saidschütz[4] (Haupt-brunnen).	Flushing,[5] in Zealand, Netherlands.	Zwolle in Overyssel, Netherlands.	Svanda[6] in Banat, Hungary.	Highgate,[7] near old Churchyard.
Well or spring . .	Spring	Spring	Spring	Spring	Spring	Well
Age or character of strata	Volcanic	Volcanic	Alluvium on Eocene	Alluvium on Eocene	?	Eocene (gravel and clay)
Name of Analyst . .	Struve	Steinmann	Gunning	Gunning	Ragsky	Noad
Grains of nitric acid in imperial pint . .	0·781	16·459	1·463	1·120	2·379	4·238

I was struck with the circumstance that the springs which contained by far the largest quantity, arose in a volcanic district.[8] The similarity in this respect of Aden, actually an extinct volcanic crater, is at once suggested; the trappean formation of the Deccan, in which Nassik stands, is no less of volcanic origin, though under altered circumstances. May we surmise, then, that the volcanic nature of the superficial strata is in some way favourable to the occurrence of nitric acid? Before proceeding to this question, let us dispose of the other instances recorded above.

The occurrence of nitric acid in the Highgate well explains itself. The well is close to the old and crowded churchyard, the organic matter from which, undergoing putrefaction, evolves ammonia, and the nascent ammonia, oxidised by the atmospheric air in the loose earth, is converted into nitric acid. It is a notorious fact that while the deep wells of London, which are sunk through the London clay, yield an exceedingly pure, though often alkaline water, the water of the shallower wells is generally contaminated with organic matter and nitrates. In the water from the parish pump of St. Clement Danes, in the Strand, which, in accordance with a venerable, but somewhat disgusting ancient practice, was placed close to the churchyard railings, the same thing was observable in a very marked degree. In the springs in the Netherlands, and the Banat mentioned in the table, the nitric acid is not present in any large quantity, and I have no data on which to explain its occurrence.[9]

Nitric acid is not a constituent of any rock masses or strata; it is found in minute quantity in rain water, but, with this exception, there is no doubt that it is exclusively formed at or near the surface of the ground (the production of nitre in the so-called nitre plantations is a notable instance of its mode of formation); hence, the nitrates must be among the first matters dissolved by the rain water as it percolates downwards, while the other salts are more gradually dissolved out at a greater depth. Considering the abundance in which alkaline and earthy nitrates are found on the surface of the ground in India, it is a matter of considerable surprise that they have not been observed more frequently in the water of springs and wells; but this, apart from the limited number and accuracy of observations that have been recorded, may be explained, I think, by the circumstance of their formation at the surface. The fact

[1] "Analysis of Inorganic Bodies," translated by G. O. Rees, 1833, p. 88.

[2] Griffin's "Translation," 1831, p. 374.

[3] Brande's "Manual of Chemistry," Fourth Edition, 1212.

[4] Ure's "Dictionary of Arts," &c., 1851, Suppt., p. 266.

[5] Liebig and Kopp's *Jahresbericht*, 1854, p. 767.

[6] *Ibid.*, 1853, p. 712.

[7] *Quarterly Journal of Chemical Society*, iv. 20; Pereira's "Materia Medica," Fourth Edition, i. 299.

[8] In the list given, in Ure's "Dictionary of Arts," &c, Saidschütz is said to be situated in a volcanic region; I have not been able to discover its precise locality. The most marked volcanic region in Germany is the Eifel district on the Rhine, although a line of volcanic action of older date extends from thence eastward as far as Silesia. (See "Daubeny on Volcanoes.")

[9] Lyell mentions the existence of no less than "five distinct groups of volcanic rocks" in Hungary, and also that "pumice occurs in great quantity." ("Manual of Elem. Geol.," Fourth Edition, 421.)

is, that, unless the ground is unusually porous, or the fall of rain excessive, these surface salts are not carried down to any great depth; and as the upper surface dries, the saline solution continually remounts upwards by capillary attraction, leaving, by its own desiccation, the saline efflorescence which we observe so abundantly in the drier parts of India; thus the nitrates, for the most part, merely follow this alternating march from a few feet in depth to the surface, and *vice versa*.

But if the concomitance of a large amount of nitric acid with volcanic formations be anything more than accidental, how are we to explain it? Let us enumerate the circumstances which are essential to the formation of nitric acid; they are:—1st, ammonia, or substances capable of producing it, as nitrogenous organic matters; 2nd, oxygen; 3rd, an alkali or alkaline earth, which, by its so-called disposing affinity for the acid, determines the combination. There is a fourth and scarcely less essential condition, the presence of a body which is capable of acting as a medium of combination between the oxygen and ammonia. Now, volcanic products are very rich in alkalies, and, what is more, they are in many instances exceedingly prone to decomposition and disintegration by meteorological agencies, whereby the alkalies become set free. Oxygen is, of course, always at hand. It is not so evident at first sight how volcanic formations can meet the remaining two conditions. Organic matter, as such, they can hardly contain; and, if ammonia is there, it is clear from their origin that it cannot be in the solid substance, but only in the interstices of the fragments or on their surfaces; and I see no reason why this should not be the case, but, on the contrary, much to make it probable. A great number of solids possess, in different degrees, the power of condensing gases upon their surface, ammonia in particular; and when the surface is multiplied by porosity of structure, this condensing power becomes perfectly enormous. The property is most marked in platinum finely divided, as in platinum black, less so in spongy platinum; less again, but still in a very marked degree, in charcoal, and by a decreasing gradation in pumice stone, oxide of iron, alumina, common clay, and sand. Has pumice, then, or pumice-like scoria, such as the loose cindery mass upon which the cantonment of Aden is built, the power of condensing and oxidating ammonia, in presence of the alkali furnished by its own disintegration? The question might be solved by an examination of the well water of pumice-yielding districts. If Saidschütz be, as I suspect, in the Eisfel district, this may well be the origin of the nitric acid in the water, as pumice is found in great abundance in the neighbourhood, especially of Neuwied and Andernach, being used as a building stone at the latter place. I am in doubt how far the occurrence of nitric acid in the wells at Nassik can be explained in this way, as it is scarcely probable that porous scoriæ are found there. Perhaps, considering how very local the distribution of the nitrates is in these wells at Nassik, and the circumstance alluded to of the quality of the waters being liable to great and sudden variation, the nitric water may find its way from near the surface through open fissures in the rock, which allow it to pass at times with great freedom and rapidity.

Dr. Bradley notices the existence of scoriæ on the edge of the crater of the Loonar lake in the Dekkan[10]: does the water of the lake contain any nitrate? Mr. Malcolmson states the solid constituents in 1000 grains of the water to be:—

	Grains.
Muriate of soda	29
Sesquicarbonate of soda	4·2
Sulphate of soda	0·1
Potassa	a little
	33·3[11]

But nitric acid may easily have been overlooked. A fresh analysis of this water is much to be desired.

The question of the formation of nitric acid[12] and of the circumstances which favour it, appears to be one of peculiar interest in this country, where the production of saltpetre is so abundant as to give India an almost complete monopoly of the article in the commerce of the world. What connection is there between the occurrence of carbonate of soda in the soil (*Sujjee muttee*, or Dhobees' earth) and that of nitrate of potassa? Does carbonate of potassa ever occur in the soil, as carbonate of soda does? I strongly suspect that the greater part of the nitric acid is, in fact, in combination with soda, and that in the rude native methods of extracting the saltpetre, the nitrate of soda is left behind in the mother-liquor, or drains away from the moist salts in the process of carriage. I would urgently recommend a more careful study of the nitre-yielding earths, as, if my conjectures are correct, an immense saving might be the result of the application of a little scientific knowledge; for I am persuaded that the productive power of India, in regard to the nitrates at least, is capable of being extended to many times its present amount.

(To be continued.)

On Atmospheric Ozone,[13]

by Dr. T. Moffatt, *F.R.A.S., F.G.S., &c.*

The mean daily quantity of ozone is greater with readings of the barometer below than above the mean, and greater when the range of the barometer and the number of its oscillations are above the mean. It is greater when the mean-daily and dew-point temperatures are above the mean, but greater when the degree of humidity is below than when above the mean. When the wind

[10] Carter's "Geological Papers of Western India," p. 766.

[11] *Ibid.*, p. 30.

[12] On the formation of nitric acid, see Liebig's "Chemistry of Agriculture," Part II., chap. viii. and Knapp's "Chemical Technology," I., 356 seq.

"Kuhlmann supposes that, in the formation of saltpetre, when the mixture contains no carbonate of potassa, but only carbonates of lime and magnesia, ammonia is first formed from the nitrogen of the decomposing organic matter; that this forms, with the oxygen of the atmosphere, nitrate of ammonia, which, with the carbonates of lime and magnesia, is decomposed into nitrates of lime and magnesia, and carbonate of ammonia, so that the ammonia is at once the agent in the formation of nitric acid, and of its transfer to the fixed bases. The same observer invariably found ammonia in the crude saltpetre ley, combined partly with carbonic acid and partly with fixed acids. This is also in accordance with the experiments of Collard de Martigny, who found that when milk of lime was kept in a closed and partly-filled vessel, with a little ammonia, and frequently shaken, for six months, nitric acid was formed. Longchamp (*Ann. Chim. Phys.*, xxxiii. 5; xxxiv. 215) maintains that nitrogenous organic compounds contribute nothing to the formation of saltpetre; but that the water contained in porous substances, such as chalk, absorbs oxygen and nitrogen from the air, and condenses them into nitric acid. The experiments of Gaultier de Chaubry (*Ann. Chim. Phys.*, lii. 24), according to which great quantities of nitrates are found in limestone hills, which contain but a mere trace of organic matter, favour this view. It may, however, be admitted that, under certain circumstances, as in electrical discharges in the air, the nitrogen, the nitric acid, and the carbonate of ammonia of the atmosphere, contribute to the formation of saltpetre, without denying that, in ordinary cases, the nitrogen of the organic matter plays the principal part. (Gay Lussac.—*Ann. Chim. Phys.*, xxxiv., 56; compare Fontenelle, *Journ. Pharm.*, 14), Gmelin, "Handbuch der Chemie," 4te Aufl. I. 801.

[13] Read before the British Association.

is from points of the compass between N.W. and S.E. by N. above the mean number of times, ozone is at its minimum, and when it is in point SS. of these above the mean number, it is at its maximum. It is also at its maximum when the wind is above its mean force. When rain is above the mean quantity ozone is also at its maximum, and also with hail; but the quantity is smaller on days with snow and sleet than on days without them. With fog it is below the mean quantity. It is above it with cirri, halos, aurorœ, and the zodiacal light, but below it with thunder, thunder and lightning, and thunder storms; and it is at its maximum with negative, and minimum with positive electricity. The mean daily quantity is greater with decreasing than with increasing readings of the barometer, and it is three times greater with wind in points S. of E. and W., than it is in points N. of these,—the greatest quantity (3·5) with S.W., and the smallest (0·8) in the N.E. points. Ozone periods may be said to commence invariably with decreasing readings of the barometer and increase of temperature, and with winds from S. points of the compass; and to terminate with increasing barometer readings, decrease of temperature, and wind from N. points of the compass. These results are from 296 periods. By far the greatest number of ozone periods commence in S.E., and a great majority terminate in N.W. points. Indeed, although the commencemement of ozone periods in N.W. points is not uncommon, the S.E. may be called the points of their commencement, and the N.W. the points of their termination. The quantity of ozone is greater in the night than in the day. It is greater with new and full moons than with the first and last quarters, and it also varies with the seasons. It is greater in January, February, and March, than in April, May, and June; but greater in the latter months than in July, August, and September. In these it is at its minimum, and it again increases in October, November, and December. The greatest quantity is in April (2·3) and December (2·4), and the smallest in July (1·3) and August (1·3). The greatest number of ozone days is in April (25), and the smallest in August (29) and November (17). Whatever tends to a deflection in the direction of the wind leads to a corresponding result in ozone observations, and a town, chemical works, drains, and cesspools, in fact, at any locality, in which the products of combustion and decomposition are in sufficient quantity to decompose ozone, the air will be de-ozonised, and the wind or current passing over it will be non-ozoniferous. The quantity of ozone increases with increase of elevation above the level of the sea. The following results were obtained from observations taken at fifteen stations along a tidal river and its estuary. The stations varied in height from three feet to six hundred feet; and in distance from the river, from its bank to eight miles inland. Some of the stations were in towns and villages; from these we find that ozone, as a rule, increases with increase of elevation, and decreases with increase of distance from the river; and that it is invariably in greater quantity in the open country than in towns and villages. This, I believe, is a universal law. It is the same on the Alps as at lower elevations. The following results I obtained from observations forwarded to me by a member of the Alpine Club. The observations were taken at elevations varying from 740 to 8000 feet. The mean daily quantity of ozone from 740 to 2000 feet is 15; from 2000 to 4000, it is 33; from 4000 to 8000, it is 77. [The degree of humidity at the lowest elevation was 58; at the next, 83; and at the last, 83 also.] Ozone is a highly oxidized body, and it is easily decomposed by oxidable substances. If a test-paper prepared with iodide of potassium be freely exposed to the air in a locality where the quantity of these substances is at a minimum, it will in time become deeply coloured brown, and ozone will be said to be at its maximum. If a similar paper be placed in a locality where the quantity of oxidable substances is at a maximum, as over or in the neighbourhood of drains and cesspools, the paper will remain uncoloured, and ozone will be at its minimum; and if the slip that becomes brown be placed in the latter place, it will lose its colour. In the first condition the ozone oxidizes the potassium and sets the iodine free. In the second, the ozonised air meets with incompletely oxidised substances, which are more easily oxidable than the potassium; and in the third instance the brown colour of the paper is removed by sulphuretted hydrogen. The ocean, with the wind that blows over it, is represented by the first condition, and the land, with its wind bearing the products of combustion and putrefaction, by the second and third conditions. The conditions of an ozone period are undoubtedly those of the south or equatorial or ocean current of the atmosphere, and those of a no-ozone period are as clearly those of the north or Polar or land current. With the former we have low readings of the barometer, with the maximum of its range and oscillations increasing mean-daily and dew-point temperature, maximum of rain, prevalence of cirri, halos, and high winds, with negative electricity; with the latter we have high readings of the barometer, minimum of range and oscillations, decreasing temperature, no halos, no cirri, low winds, settled weather, and positive electricity. The atmospheric conditions, with ozone and those with no ozone, are so invariable, and ozone periods so frequently commence and terminate with S.E. and N.W. winds, that the points of the compass might not inaptly be arranged into four sets—viz., the equatorial or ozone points, the Polar or no ozone points, and the transition points, the south-east, the points of transition from the north or Polar to the south or equatorial, while the north-west are those of change from the latter to the former. In a medico-meteorological sense I am not prepared to state that atmospheric ozone produces any form of disease, but I have no hesitation in saying that it prevents diseases of the epidemic character, by removing their causes. The maximum of diseases undoubtedly takes place while the ozoniferous current has the ascendancy, but they are of a sporadic nature, and are caused by the vicissitudes of weather, electrical influences no doubt playing an important part. The maximum of deaths takes place while the wind is in N. points. By far the greatest number of diseases, however, take place in the N.W. and S.E. points, or at the commencement of ozone periods, and these are chiefly affections of the nervous and muscular systems, from which it would appear that derangements in the nervous and muscular forces take place at the time of transition from the no-ozone and positively electric to the ozone and negatively electric current of the air. The diseases peculiar to the calm, which is also a no-ozone condition, are of an epidemic nature, such as cholera and choleraic diarrhœa. These results are deduced from 2727 cases of disease and 1149 deaths which occurred at Hawarden in a period of ten years. As the S. is the higher and ozoniferous current, and the N. the lower and no-ozone current of the atmosphere, in a medico-meteorological sense there ought to be some analogy between the higher strata of the atmosphere and the S. wind and between the lower strata and the N. wind, and observation shows that as

regards ozone and deaths they are similar. All who have paid any attention to the atmospheric conditions of a cholera period must have observed that the readings of the barometer are remarkably high, that they slowly attain their maximum, and that when they begin to decrease they as slowly approach their minimum. While the barometer is increasing, the wind continues to veer from N. to N.E. and E., until there is a perfect calm. At first the air is clear and the sky cloudless. The air becomes less clear, it thickens to haze, and the sky can no longer be perceived. There is no ozone, and the brown test papers rapidly lose their colour. At the commencement of the calm there are a few cases of diarrhœa, and as it continues cases take the character of choleraic diarrhœa, and at last a few cases of cholera occur. The calm continues, the haze thickens, and the cases of cholera *pari passu* increase in number and severity. The haze becomes a dry fog, things communicate a gluey sensation to the touch, insects fly about in swarms, and the epidemic reaches its height. The barometer having reached its maximum, begins gradually to drop, the haze becomes more of the character of fog, and if it can be seen through cirri will be seen hovering in the higher regions of the air, or moving slowly northwards. The south current is now approaching, the barometer continues to fall, a gentle motion of the air is perceived from S.E. Ozone is detected; there may be rain; there may be a thunderstorm. The wind increases in power and ozone in quantity, and cholera disappears. The rationale of this medico-meteorological process is this: The first part of the process was the north current gaining the ascendancy; and, as it is the land current, bearing the products of decomposition, ozone is reduced to its minimum. While the air keeps in motion these products do not accumulate in great quantity. The barometer begins to drop. The north current falls back, and is succeeded by the calm. The products of putrefaction go on accumulating; there is no renewal of air, and sulphuretted hydrogen can now be detected. Cholera cases go on increasing as the poisonous substances accumulate. As the barometer decreases slowly, the south current slowly advances; but that it is advancing is shown by the cirri in the higher strata of the air. The air becomes more moist, because the moist current is approaching. The south or ozoniferous current at last gains the ascendancy, and cholera vanishes, because the incompletely oxidised bodies, the poisonous substances —perhaps hydrocarbons—are rendered innocuous by the ozonised air affording them oxygen. These views are supported by the facts that diarrhœa and choleraic diarrhœa are most common in the autumn months, and then ozone is at its minimum, and that ozone is invariably absent during cholera periods. Cholera is also observed to advance from east to west; so do the Polar current and the calm. I may state, also, in support of these views, that during the cholera epidemic at Newcastle, in 1853, the calm prevailed and ozone was at its minimum. From the 24th of August to the 11th of September, 1854, ozone was only once perceived, and then in a minimum quantity. Cholera was then at its height in London. On the 10th of September I wrote to a friend, stating that the S., or ozoniferous current was approaching, and requested him to watch its effects upon the epidemic. On the 11th we had a S. wind, with ozone, and from that day the number of cases of cholera diminished. In conclusion, I have to observe that in making ozone observations the test paper ought to be kept in the dark; that sulphuretted hydrogen, ammonia, and moisture cause loss of colour.

Dr. Andrews said that in order to determine the nature of the body said to be ozone, it should be ascertained that it possessed all the qualities of ozone. He had found many difficulties in his researches on the subject; but so far as his own opinion went, he was inclined to believe that what Dr. Moffatt spoke of was ozone. A very simple method of discovering it was to expose a piece of paper, moistened in a solution of the hydrate of potassium, to the atmosphere; if there was any ozone in the air the paper would soon become coloured. It was very interesting to expose these papers at different places for the same length of time, and the depth of discoloration would give the relative quantity of ozone in the air. He thought it was important to find out the causes of the destruction of ozone in the atmosphere, because it was quite clear that the power of destruction was as actively at work as the power of its production. Of all the tests of ozone, he thought the most delicate was that of metallic mercury.

Dr. R. Angus Smith said he had occasionally made experiments with ozone, and he could confirm the observations of Dr. Moffatt as to its absence from large towns. He had never yet found that ozone approached Manchester within half-a-mile. The test which had been mentioned was a very valuable one. He did not mean to say that the effects were caused by the existence of ozone, but it was very important as an indication of the state of the atmosphere. He therefore hoped Dr. Moffatt would continue these observations, as he was sure he was on the right track. There had been several objections to these observations on ozone made by chemists, who contended that the indications were referable to the acidity of the atmosphere. From the absolute non-existence of these indications in Manchester, he could not refer them to acidity, because the rain of Manchester was nothing less than diluted vitriol, many hundred tons of vitriol falling upon our heads in Manchester in the course of a year. (Laughter.)

Mr. J. Glaisher, F.R.S., said this was a question to which he had paid particular attention since 1848. He obtained test-papers from Dr. Moffatt, and he placed them at Greenwich Hospital, on the banks of the Thames; at the Greenwich Royal Observatory; and at Blackheath. The results were, that the papers were never coloured at the Hospital, whilst they were frequently coloured at the Observatory, and always coloured on Blackheath. From his investigations into ozone, he had learned to be careful in his deductions. He pursued his investigations at different hospitals, and placed the papers over several of the cholera patients, and when the papers were returned to him, he found several were deeply coloured, whilst others were uncoloured. He found, however, that where there was no colouration there was the greatest number of deaths. There was no indication of ozone whatever at St. Thomas's Hospital, or, in fact, near the Thames, except on occasions when the wind was moving there would be a slight tinge on the paper. His next discovery was that there was more ozone by the sea than inland,—about four times as much. In towns there were seldom any indications of ozone. As to height, ozone increased with elevation, or the purity of the air. Ozone was destroyed by the exhalation of animal matter in these districts. He agreed with Dr. Moffatt in all respects but one, and that was with regard to the barometer; for he had never yet been able to trace any connection between the variation of the barometer and the health of man. He agreed with Dr. Moffatt that a wind off the sea produced a maximum of ozone, but he did not think it was produced by any particular wind blowing

always in one direction. Taking Dr. Moffatt's researches altogether, they had been a great assistance to him (Mr. Glaisher). He was sure Dr. Moffatt was in the right path, and he hoped he would continue untiring in following out his present results.

Dr. DAUBENY said that the observation that there was a great deal more oxygen in the neighbourhood of the sea than in the interior of our island, was quite in accordance with the theory that the ozone was destroyed by animal and vegetable exhalations. He might take this opportunity to produce a specimen of fluor spar from Bavaria, which, if rubbed, appeared to contain ozone. He should like to know if it was a fact that there was an entire want of ozone on the top of the Alps.

Dr. MOFFATT said that, with regard to the barometer, he did not know that he could attribute disease either to the high pressure or low pressure of the atmosphere; but he believed it was the change from one pressure to the other that caused disease. That might be electric. Both the animal and vegetable kingdoms could adapt themselves to several inches of pressure, but it was the change from one pressure to the other which caused the disease,—whether it was electric or moisture he did not know.—In reply to a question as to what the test-papers were made of, Dr. Moffatt explained that they were made of iodide of potassium, starch, and water. It was difficult to make two packets alike, and the best way would be to purchase them of Negretti and Zambra.

TECHNICAL CHEMISTRY.

On Bleaching,[1] *by Mr.* HENRY ASHWORTH.

THE art of bleaching may be considered to have taken date from the earliest ages, probably from the time when human knowledge had become extended to the fabrication of clothing; and the inventor may have been the first housewife whose personal feelings induced the desire to enjoy the comeliness and the comfort of clean linen. Primarily, the operation has been accomplished by soap and water, the friction of the human hands, and exposure to the whitening effect of the atmosphere. Theoretically speaking, the bleaching of the present day, in all its enlarged proportions, is accomplished out of the same elements, although in their application they may have been altered or modified to suit the economy of modern chemistry, and the mechanical appliances which now supersede the manipulations of a by-gone age. The interesting character of the progress of these changes it will be our province to endeavour to trace. The ancient writers do not appear to have left us any details on the subject, and the knowledge we possess extends only as far back as the middle of the last century. Previous to that time, the cotton manufacture was scarcely known, and the linen manufacturers of the North, who knew nothing of bleaching, used to send their brown fabrics to be bleached in Holland, and they were received again in the course of eight months, and sold under the definition of brown Holland. In the year 1749, the practice of lime bleaching was introduced, and the cloth was then steeped in alkaline lye, which was called "bucking." The subsequent process of bleaching was done by exposure on the grass, which was called "crofting," and these operations were repeated five or six times, extending over a period of eight or ten weeks. The first advance upon this tedious process was made by Dr. Home, of Edinburgh, who substituted a very weak solution of sulphuric acid for the buttermilk, the rye meal, and the bran operations previously employed, and by this means he accomplished the same result, and in a shorter time than by the buttermilk process, which had required two months. In the year 1787 an important change took place in consequence of the discovery of M. Scheele of Sweden, of a chemical compound, such as is now designated chlorine, and this was used as a substitute for exposure to the atmosphere. The repeated experiments of Berthollet added considerably to the facts already known; but the practical effects of these discoveries were more fully brought out by Mr. Watt and Dr. Henry, and it is to them that the chief merit is due of introducing the new mode of bleaching cotton goods. To those who are familiar with the history of the cotton manufacture, it will be apparent that bleaching, as a distinct pursuit, had by this time become a necessity of the trade, therefore the manufacturer consigned to the bleacher, who was originally called a whitster, his woven fabrics in the state in which they came from the loom, loaded as they were with impurities; and the following is described as the course of operations by which he undertook to whiten them. The loose fibres of cotton adhering to the surface of the cloth were removed by passing the whole length of the piece over a curved plate of iron heated red hot,—an operation that required to be done with great velocity to prevent any injury being sustained to the goods. The cloth was then deposited in a cistern of water, or in a weak alkaline lye, where it would remain, perhaps for some weeks, until the flour paste, used as dressing by the weaver, had become softened by fermentation. The removal of the paste and other matter contained in the web was accomplished by the agitating process of a dash wheel, or cylindrical box revolving on its axis, having four compartments or internal divisions radiating from the centre, in which the bundles of cloth were deposited. A supply of water was being injected at the sides of these compartments to carry off the impurities as they were liberated by the jolting concussions created at every revolution of the wheel. This invention was deemed a great advance upon the previous practice of dragging the pieces by hand through a stream of water in the water pits constructed for the purpose. The cloth was next boiled in lime water, and another operation of the dash wheel succeeded. The lime water had to be expressed from the cloth by passing the whole length of each piece betwixt a pair of revolving rollers called "squeezers." It was then immersed in a composition called "chemical," and when taken out was carefully washed in cold water. These operations, more or less varied in their character and arrangement, were repeated a number of times; the cloth had some weeks of exposure in the grass fields, with an occasional sprinkling of water to aid the process of whitening, and was then considered to have received a bleaching; the process of drying was in long sheds, constructed mostly of wood, having openings at the sides with sliding doors; and the pieces were suspended by hand upon lines of railing until they had become sufficiently dried by the atmosphere. When taken down, every piece was neatly folded and compressed by screw pressure, and this was deemed the finishing process before delivery at the warehouse of the manufacturer.

It is from such a beginning, and within living memory that we shall endeavour to trace the successive changes which, in the course of sixty or seventy years, have led

[1] Read before the British Association.

to the establishing of that important branch of trade, now so intimately connected with the cotton manufacture of this and other countries. The chemical preparations originally adopted were somewhat primitive: the acids were derived, to some extent, from an immersion of the cloth in sour milk, although the use of a weak solution of sulphuric acid was the more prevailing practice. The alkali which is the basis of soap was derived from the ashes of burnt fern, sea-weeds, or other similar products. The oxygen of the atmosphere was employed to whiten the grey fibre of the cloth, and a decoction of sorrel was used to remove the stains and iron moulds. About the year 1795, it had become obvious that the growing demands of commerce required a more efficient agency than could be derived from such rude elements. Severe pressure on the trade was felt from the enormous amount and cost of labour required, the heavy expense and the inferior quality of the drugs then in use, the rental paid by the bleacher for so large an extent of grass land as he found it necessary to occupy with the exposure of his cloth to the atmosphere, together with the unavoidable delay, uncertainty, and pecuniary losses, which were constantly occurring from unfavourable weather and other causes. The manufacturer also suffered greatly from the frequency of his disappointments, and the inconvenience and loss he sustained from the necessity of having his capital in goods lying three months in the bleach grounds. The emergency which had now become so apparent had the effect of bringing out inventions and improved processes. These succeeded one another with great rapidity, and those proprietors of works who possessed intelligence and capital made rapid progress; although there were other instances in which the want of capital or the absence of enterprise prevailed, and in these cases there remained a lingering adherence to those antiquated usages which were being superseded in other concerns. Every one knows that in whatever manner bleaching is done, it must be effected by means of true chemical agency; and therefore it was to the chemist that the bleacher had, in the first instance, to look for the discovery of more potent agents to effect his object.

The first great triumph in this department was the discovery, in 1798, by Mr. Tennant, of Glasgow, of a method of making saturated liquid chloride of lime,—an article which was found to answer quite perfectly all the purposes required by the bleacher. This invention, for which he took out a patent, consisted in the substitution of lime for potash. His patent right was resisted by the bleachers of Lancashire, and was set aside by the verdict of a jury. The grounds of this decision were, that the patent included a mode of "bucking" with quicklime and water, which was not a new invention; and because one part of the patent was not new, the whole of the claim must be set aside; and by this decision the use of liquid chloride of lime in bleaching was thrown open to all. It was deemed an unfortunate circumstance that, in consequence of an error of expression in describing his process, Mr. Tennant should be deprived of the fruits of a laborious investigation, extending over several years. There was a strong feeling of sympathy manifested, and the bleachers of Lancashire presented him with an expression of their grateful acknowledgment by a service of plate, which Mr. Tennant accepted; but it was most in accordance with the character of his original design to press onward with his discoveries, and to bring his first invention to a still more practical issue. He, therefore, adopted a new method,—one which at length he completed and secured by patent, for impregnating quick lime in a dry state with chlorine, and in this instance his right remained uncontested. He lived to enjoy his pecuniary reward; and the manufactory which he established in Glasgow is at this time the largest in extent of any of the kind in Great Britain. The supply of alkali, which was being derived from the burning of fern, and from the icineration of sea-weed on the coasts of Scotland and Ireland, having become insufficient, it was supplemented by the importation of barilla, an article produced in the same way upon the coasts of Spain, Sicily, and Sardinia. The alkali procured by such means was very crude and very unreliable in its action, and the use of it was at length superseded by potash obtained from the clearing and burning of forests in the United States. At length the consumption of the article had become so greatly enlarged, and the price so enormously high, that the demand for the production of alkali became an object of mercantile attention. Chemical science stepped in, and very quickly responded to this appeal on the part of the bleachers. The consequence was, that an artificial soda was invented, called "soda ash," or British soda, which, in regard to cheapness and efficiency, has caused the bleachers to dispense with the use of potash; and the quality of the article has so successfully commended itself to the consumers, that the manufacturers are now annually exporting British soda of the value of one million sterling over and beyond the requirements of the bleachers, soap makers, and glass manufacturers of our own country. It is worthy of remark that the great bulk of our shipments of British soda are to the United States, from whence, only a short time ago, we were importing very large quantities of potash, the production of their forests. Thus, by an art which half-a-century ago was almost unknown, and by the agency of our coal as fuel, we have succeeded in converting certain products which we dig from under our feet, such as salt, pyrites, and lime, into one of the most important branches of manufacturing chemistry. These discoveries in chemistry may appear extraordinary, although they are not more important in the economy of bleaching than are the mechanical arrangements which have superseded the exposure of labourers, in all states of the weather, to the accustomed drudgery of the "crofters" of old. The "crofters," of whom we have spoken, bore the appearance of remarkably strong men; their working dress was of thick white flannel, called "gladding;" the cut of the coat was peculiar, having a loose, open appearance, and a low, flat collar, on which the shirt collar usually rested. They had their necks uncovered; and, their employment being so much exposed to moisture, they seldom wore stockings. Altogether, they assumed a bearing of unconcern about the state of the weather, and were quite regardless of the splashing of water. Their employment consisted mainly in the handling of wet cloth, and in removing it, either by hand or by wheelbarrows, from one operation to another. Perhaps the most distressing part of their labour was that of carrying upon their shoulders a pile of wet cloth, rising to some height above the head, which they conveyed to some considerable distance in the fields, and spread upon the grass. In the severity of the winter season there would be drippings from the cloth, forming icicles, which would be adhering to the skirts of their clothing. It has been through a succession of mechanical inventions that these laborious operations have been dispensed with, and, one after another, they have been handed over to the power of the steam-engine. The machinery of the dash-wheels are in a great measure

superseded; the use of wheelbarrows for the removal of cloth from one operation to another are not now required; the suspension of wet pieces upon wood railing in an open shed for the purpose of drying has passed away; all this work is now done under cover; the drying process is carried on in heated rooms; and the suspension of the cloth is accomplished by an ingenious application of machinery. Practically speaking, bleaching operations have been revolutionised; and probably the most efficient labour-saving invention has been a mechanical arrangement, or, as it is termed, a continuous system of cloth working. By this method, it is not now necessary to conduct the bleaching of individual pieces singly, one by one, but to have the ends of them sewed together by hundreds in a consecutive string, and have them drawn through a number of operations in their ordinary succession; the regularity of the work being attended to by boys, and the superintendence by men. It will be obvious that, by the various means referred to, the operation of bleaching has been much simplified, and the expense reduced; but, meanwhile there have been great changes, and eventually an increasing demand for what is usually termed "finish," which consists of a skilful application of calendering, pressing, rolling, and otherwise rendering a piece of plain cotton as near as possible in accordance with the design of the manufacturer or the exporter, who may undertake to gratify the taste of the consumers in the various markets of the world. To such an extent has this rivalry or competition by "finish" been carried, that the machinery, labour, skill, and cost of extraneous materials required, have occasioned an expenditure that is said to exceed all the other expenses previously incurred in the bleaching. Dyeing has also been associated with bleaching and finishing; and the class of goods which are embossed and figured by pressure now belong to this department, and afford another variety in the attractions of cotton fabrics. The result has been that the time required for the operation of bleaching is now about as many days as formerly it required weeks to accomplish. Honour to British genius that these advantages have been derived to our country.

The general public will no doubt feel curious to ascertain whether any and what proportion of the money saving thus effected has reached the consumer; some other portion of the public will inquire to what extent the advantages thus achieved by science and art have been shared by the operative class employed? It is not expected that much concern will be manifested about the interests of the proprietor, and it is not unreasonable to suppose that a still more minute inquiry will be raised about the "human machine," more especially, whether, during the progress of these advances in manufacturing art, the material, moral, and intellectual condition of the working class has been made to keep pace with all these improved manipulations, which, amidst the struggle of changes, have destroyed the character of many employments, but have greatly increased the whole number of persons employed? These inquiries it will be our endeavour to satisfy. The advantages shared by the consumer will easily be reckoned. We have before us a printed card, or list of prices for bleaching issued by a leading firm in the year 1803. At that time the charge for bleaching a well-known description of cloth was 7s. 6d. for a piece of 28 yards, and it is now 6d. The case of the labourers employed in bleaching 60 or 70 years ago was, as before stated, a very harassing one; they suffered severely from exposure to wet and cold, and, as a consequence, from rheumatism and asthma. The earnings of a "crofter" would be from 10s. to 15s. per week. Upon wages so scanty, and with some uncertainty of employment, their mode of living was necessarily inexpensive. Oatmeal was the staple commodity of their food. They used it as porridge; their bread was of oatmeal, either in leavened oat cakes, or baked in the form of a loaf called jannock, which is said to have been introduced by the refugee Flemings; and animal food, with the exception of bacon, was seldom found at the working man's table. Now-a-days, the workmen in bleach works perform all their work indoors, and are, therefore, no longer exposed to the coldness and moisture of the former period. Their wages are increased in a proportion which cannot easily be estimated, and their employment is one of great regularity. They have nearly ceased to consume oatmeal; jannock is unheard of; oat cakes are seldom seen; and their tables are now spread with wheaten bread, animal food from the shambles, and all the other articles which usually enter into the consumption of families in the other grades in life. The social condition of the operative bleacher of early times cannot easily be separated from the rest of the working population of that day, neither could they now be described in any other manner than that which would apply to the operatives around them in other pursuits. We may refer to their mode of pleasure-taking as affording in itself a very appreciable indication of the past and present. The amusements which formerly prevailed were rude and boisterous; now they are more refined and intellectual. Bull-baiting, bear-baiting, and cock-fighting were amongst the common amusements of the day, especially at the wakes and fairs. The game of foot-ball was a very favourite one, so much so that the people of one place would make selection of their combatants and have them pitched against those of some other place, and these would contend in very ardent strife for the renown of mastery. Indeed, so very popular was this game, that a match at foot-ball was, upon one day in the year, tolerated by the inhabitants in the streets of Bolton. The whole of this is now given up. The game of cricket is becoming a popular one, and others equally harmless in their character are being introduced. Their manners have been designated by the historian as "frank and primitive." Therefore, upon such a foundation of industry as that already described, and with elements of character admitted to have been generous and progressive, it will not be matter of surprise to discover that at the present day a commendable position has been attained by this class. Provident Institutions are becoming numerous, and upon holiday occasions the members are fond of the imposing effect of a display of their numbers and respectability. The parade of their flags and other official insignia sometimes disclose a designation of the body which, amongst a manufacturing class, may appear somewhat grotesque, such as Druids, Odd Fellows, Gardeners, Foresters, and the like. There are a great many depositors in the savings'-banks; the co-operative societies have absorbed no small amount of their money savings, and the more intelligent have been engaged in the conducting of mercantile pursuits of these concerns. Perhaps there is no other illustration of the spirit of progress so comprehensive or so pregnant with results of a promising nature as the following:—Manchester, which is the industrial centre of the cotton manufacture, is also the centre of 127 Mechanics' Institutions, associated together as the Lancashire and Cheshire Union. The inquiring mind, when put in motion and stimulated by example, is sure to take a direction resulting in intelligence. Hence, among other means, they have

recourse to cheap trips by railway to some distant part of the country. The Lancashire operative does not fail to see that those who are but little above him in station have their autumnal excursions. He works hard, and why should he not shake off, for some short period at least, the burden of wear and tear of body and mind, and transport himself, with other members of his family and friends, over some other portion of the earth's surface which he has not seen, and share the healthful recreations and the pleasures attainable in modern life? Moreover, by an excursion he falls into the way of new scenery, new faces, strange remarks, historical associations, and observations of other trading pursuits to which he has not been accustomed, all tending to enrich the mind, gratify the senses, and create new impressions of delight. In this way the traveller, whose mind is open to profit by what he sees, returns home instructed, and at an expense so slight as to make no conceivable inroad upon his savings fund.

Seventy years ago Sunday-schools had made but slight progress. There were but few persons who could read, still fewer who could write; and when anyone received a letter, he had to carry it away, perhaps a good many miles, to find a scholar who could read it. At the present time, Sunday-schools abound, day-schools are numerous, and the affair of carrying away a letter in search of a scholar may now, with much complacency, be put down as among the reminiscences of seventy years ago.

On the Action of Water on Lead,[1] *by Dr.* F. CRACE CALVERT, *F.R.S.*

I WOULD not have troubled this Section with bringing before them a subject which has been noticed by them several times already, if these researches (which were made in connection with a Select Committee of the Sanitary Association of this city) had not presented some interest on several points,—namely, the action on lead of a water supplied to a large population; the determination of the quantity of lead that the same water took up in a given length of time; and, further, with the hope of removing from the minds of some chemists the impression that soft surface water does not act upon lead.

These experiments have extended over a period of more than twelve months, and above 300 samples of water have been tested, and led to the following conclusions:—

First, that the water supplied to Manchester, and passing through a lead pipe used as a supply-pipe, was for four days highly charged with lead compounds, and that the quantity gradually decreased for six weeks, when the water ceased to absorb lead. But if, during that period, the water were allowed to remain in contact with the pipe for twelve hours, its action was still very marked, and it may be stated that, at the end of six weeks, the water still contained $\frac{2}{10}$ths of a grain of lead per gallon, and after three months $\frac{1}{30}$th of a grain was found.

Secondly, experiments were made on five samples of piping of the following description:—No. 1, extra tinned lead piping; No. 2, ordinary tinned lead piping; No. 3, best or virgin lead piping; No. 4, common lead piping; No. 5, block tin piping. The water was left in contact with these pipes for twelve hours, and, with the exception of the one last mentioned, all were acted on, the proportion of lead taken up by the water from the lead pipes amounting to from $\frac{1}{10}$th to $\frac{3}{10}$ths of a grain per gallon. Waters containing these quantities of lead per gallon are quite sufficiently charged with that compound to prove injurious to health if used as a beverage. I may substantiate this statement by the fact that four samples of water, which I have lately examined as having injured the health of the inhabitants of this city, contained from $\frac{1}{10}$th to $\frac{3}{10}$ths of a grain of lead per gallon. Therefore, there can remain no doubt that the water of this city may become sufficiently charged with lead to injure the health of the inhabitants.

Dr. Crace Calvert concluded his remarks by stating that, on allowing water to remain for some time in the pipes, and then again bringing them into constant use, the action of the water on the pipes is greatly increased.

In the discussion which followed,

Dr. SMITH, of Sydney, said, from experiments he had made at Sydney, he found that the action of water upon pipes made of lead and tin was much greater than its action on lead alone.

A Gentleman said that he had found that the water of Sheffield, which came from a similar source as that of Manchester, was strongly contaminated by passing through lead pipes, being to the extent of $\frac{2}{10}$ths to $\frac{3}{10}$ths of a grain per gallon.

Dr. ANGUS SMITH related several instances of serious poisonings, and even deaths, through drinking Manchester water. Though the Glasgow water was said not to be injurious to health, he believed as little as $\frac{1}{40}$th of a grain of lead per gallon would affect many persons, whilst others might not be affected by $\frac{1}{10}$th.

Dr. MACADAM said the water of Edinburgh was impregnated with lead only to the extent of $\frac{1}{400}$th of a grain per gallon.

Dr. WALLACE said that he believed the cause of the action of the water upon the lead was oxygen and nitric acid. Lime also exercised a powerful action in permitting the action of the water upon the lead. He had heard of no poisonings in Glasgow by the water.

[1] Read before the British Association.

On the History of the Alkali Manufacture,[1] *by Mr.* GOSSAGE.

IT was correct, he believed, that the manufacture of soda in Great Britain, by the special decomposition of common salt, had its commencement in Lancashire; at any rate, its largest development had taken place in this county. Previously to the establishment of the French republic, in 1793, soda was obtained almost entirely from the ashes of marine plants growing at Alicante, in Spain, Sicily, Teneriffe, and on the coast of Great Britain. Large quantities of potash were also imported from Russia and America, but now soda was exported to those countries which formerly sent us potash. The importation into France of alkali being stopped by the French Revolution, a committee was appointed by the French Convention to discover means of supplying the article from France alone. The process suggested by Le Blanc was approved of, but it was erroneous to suppose that his process was not invented before the committee was appointed. Having given an account of Le Blanc's invention, Mr. Gossage said that it was very complete, and was the same as now used in both England and France. This invention had done more to promote civilisation than any other chemical manufacture. The

[1] Read before the British Association.

poor inventor, however, met with the too common reward of talent, and after great privations died in an asylum for paupers. Sundry alkali works were erected in France, but the process was not introduced into England for some years afterwards. In 1787 Messrs. Gordon, Barrow and Co., of Aberdeen, applied chlorine, then recently discovered, to the process of bleaching. A large establishment was, in the following year, established at Bolton. At first chlorine was used in the state of solution in water, but the inconvenience of using it in that manner was overcome by the addition of potash to the water. The next step was to substitute lime for potash, producing solution of chloride of lime. This was the invention of Mr. Charles Tennant, of St. Rollox, who afterwards manufactured chloride of lime in the state of powder. This manufacture was carried out to a great extent. A great obstruction to the manufacture, however, was the high excise duty on salt, which operated most injuriously. When Mr. Tennant's patent for manufacturing bleaching powder expired, other parties began the same manufacture. Attention was directed to the utilisation of the mixed sulphate of soda and sulphate of manganese resulting from this manufacture, and carbonate of soda, in crystals was gradually introduced into the market. During the same period, Mr. Losh was making crystals of soda, and might be considered the father of the soda trade in this country. Mr. Losh finished his education on the continent, where he learnt Le Blanc's processes. After his return, he obtained permission of Government to work a spring of weak brine discovered at Walker, on the Tyne, for the manufacture of soda. He there manufactured soda crystals; but notwithstanding these essays, 1823 might be considered the natal year of the soda trade as a special manufacture in Great Britain. In that year common salt being relieved from fiscal impost, Mr. James Muspratt commenced the manufacture of sulphate of soda at Liverpool, to be used for the manufacture of carbonate of soda. Mr. Muspratt adapted Le Blanc's processes in their entirety. He had to contend with many difficulties, but he overcame them all, and reaped a satisfactory reward. Other manufacturers also commenced to make sulphate of soda, by the special decomposition of common salt, for the purpose of making soda; and it had since been found advantageous to adapt this method of working to the production of bleaching powder, by using the hydrochloric acid so obtained to generate chlorine by its action on manganese. In the early days of the soda trade no attempt was made to condense and liberate hydrochloric acid gas. The old apparatus of cylinders and Wolfe's bottles were totally inadequate for the condensing. Many plans were suggested, and amongst others he (Mr. Gossage) obtained a patent in 1836. Having demonstrated the practicability of effecting a complete condensation of hydrochloric acid by the erection and working of a set of apparatus at the soda works with which he was then connected, he introduced the plan to the trade, and it had been subsequently adopted by every manufacturer. The principle of the invention consisted in causing the acid gas to percolate through a deep bed of coke, in small lumps contained in a high tower, at the same time that a supply of water flowed very slowly over the surfaces of the pieces of coke. By this means, an almost unlimited extent of moistened surfaces might be presented to the gas for effecting its absorption, and as the same fluid descended through the tower, it met with more gas and gradually became charged to saturation; whilst, at the upper portion of the tower, any gas which might otherwise escape was exposed to the absorbing power of unacidulated water. In 1838, a French house, Messrs. Fai and Co., of Marseilles, obtained a monopoly from the King of Sicily for the export of sulphur. This caused an advance in price to 14*l.* per ton from the previous rate of 5*l.* per ton. It was soon found that in our Cornish mines and in those of Wicklow, in Ireland, we possessed an inexhaustible supply of sulphur in the form of pyrites; our practical chemists soon availed themselves of this source, for the manufacture of sulphuric acid. In working with pyrites it was found that this mineral contained sulphide of copper, as well as sulphide of iron, and, at an early period, he commenced to extract the copper from the burned residuum by smelting. At the present time, the products obtained by the soda manufacturers were soda ash, worth 3*l.* per ton; soda crystals, about 4*l.* 10s. per ton; bleaching powder, 9*l.* per ton; bicarbonate of soda, 10*l.* per ton; whilst the cost of raw materials, now used in Lancashire, are sulphur, 8*l.* per ton, for which was substituted pyrites at a cost equivalent to 5*l.* per ton; sulphur salt 8s.; zincstone, 6s. 8d.; fuel 6s. per ton. Thus, with a reduction in the cost of raw materials not more than equal to 10 per cent., the public was supplied with the products of the soda manufacturer at a reduction of at least 60 per cent. As nearly as he could obtain information, there were 50 establishments in Great Britain, in which soda was manufactured by Le Blanc's process, producing about 3000 tons of soda ash, 2000 tons of soda crystal, 250 tons of bicarbonate of soda, and 400 tons of bleaching powder per week. The total amount of these products might be estimated as exceeding two millions sterling, which was so much entirely added to the annual income of the country, excepting about one hundred thousand pounds paid for materials obtained from other countries. He must not omit to notice the prospect of a new market for British-made soda which had been opened by the successful labours of Mr. Cobden, in negotiating the commercial treaty with the French Government. Many attempts had been made to supersede Le Blanc's process, by some more direct means of operating on salt, so as to eliminate its soda at once. Up to the present time, the result of all these attempts had been the wasteful expenditure of large sums of money. Two-fifths of the total cost for raw materials was incurred for pyrites, from which to produce a supply of sulphur; and it was a well-known fact that more than nine-tenths of this sulphur was retained in the material called "alkali waste," which was thrown away by the manufacturer. Thus was presented a problem which, if it could be solved, would effect a large reduction in the cost of soda. Many chemists, both scientific and practical, had given a great amount of attention to that subject. He had been so unfortunate as to be amongst the number, as he had devoted a great proportion of his time, during a quarter of a century, and a large amount of both money and labour to this hitherto delusive subject. He commenced by demonstrating in 1838, that one equivalent of sulphide of calcium produced monocarbonate of lime and sulphide of hydrogen. This decomposition was contrary to the received views of scientific chemists of that day, as it was held that an excess of carbonic acid was needful to effect the perfect decomposition of sulphides. He was convinced that whenever the utilisation of the sulphur in alkali waste might be effected, it would be by means of this action of carbonic acid. He demonstrated also, at the same time, that one equivalent of carbonic acid would decompose one equivalent of sulphide of sodium, producing monocarbonate of soda

and sulphide of hydrogen. His present impression was, that Le Blanc's process would be modified by the omission of lime, when decomposing sulphate of soda, thus producing sulphide of sodium; and that the carbonic acid evolved by this decomposition would be applied to decompose the sulphide of sodium producing carbonate of soda, and eliminating sulphide of hydrogen, which would be absorbed by peroxide of iron, and the product in the manufacture of sulphuric acid. He had proved the practicability of all those decompositions and actions; but the ideas had still to be worked into a practical operation.

NOTICES OF BOOKS.

A Manual of Chemistry, Descriptive and Theoretical. Part I. By William Odling, M.B., F.R.S., Fellow of the Royal College of Physicians; Secretary to the Chemical Society; and Professor of Practical Chemistry at Guy's Hospital. London: Longman, Green, Longman, and Roberts. 1861.

The first part of this important and long-expected Manual is announced for publication on October 1st. We propose, in an early number, to devote some space to a critical review of its contents, and, in the meantime, will briefly draw attention to some of the leading features in the book, in most of which it will be found to differ from other chemical manuals of similar scope:—

As a rule, the atomic weights selected for volatile elements represent single volumes, and those for volatile compounds double volumes, of their respective gases or vapours.

The great majority of compound bodies are expressed, as unitary molecules, by unitary formulæ, instead of by additive, or, as they are commonly called, rational formulæ. Throughout, the algebraic sign of addition is never used to express combination.

The equivalent notation, by means of dashes, introduced by the author some years ago, and now constantly used in the original papers of most European chemists, is here employed for the purposes of elementary teaching.

The arrangement of the book is more than ordinarily systematic. The mutual relations of the elements and of their analogous compounds are largely dwelt upon, as are also the mutual relations of the various heterologous compounds of the same element. The properties of classes of bodies, chlorides, oxides, sulphates, &c., are described with greater fulness than is customary in text-books.

The compounds of mineral and organic chemistry are not considered apart in separate sections. Moreover, the doctrines of series, types, and substitutions, are applied indiscriminately to both branches of chemical science.

The technological applications of chemistry are but very briefly referred to, and the physics of chemistry only incidentally discussed; so that a more than usual proportion of space is devoted to chemistry proper, and especially to the description of chemical reactions.

The present part contains an introductory section, and an account of the elements, hydrogen, fluorine, chlorine, bromine, iodine, oxygen, sulphur, selenium, tellurium, nitrogen, phosphorus, arsenic, antimony, and bismuth, and of their combinations with one another.

NOTICES OF PATENTS.

330. *Treatment of Soda Waste and Sulphurets.* J. L. Jullion, Tynemouth. Dated February 9, 1861.

By different modes of treatment the inventor proposes to economise the oxy-sulphide of calcium refuse of the alkali manufacture, either by eliminating from it the sulphur in the free state, or by effecting its further oxidation, and so giving rise to the production of marketable compounds, having one of the alkaline earths acting the part of base.

Immense quantities of hyposulphite of soda are now being manufactured from this oxy-sulphide of calcium refuse, and in this instance the inventor appears to have in view the substitution of the cheaper bases, lime or magnesia, for the soda commonly employed. The expedient of burning out the sulphur from the waste is also contemplated in the specification.

334. *Capsules or Covers for the Necks of Bottles and Jars.* J. G. Jennings, Holland Street, Blackfriars. Dated February 9, 1861.

This invention consists in employing suitable covers, metallic or otherwise, to which a short length of vulcanized india-rubber tubing is securely attached, so as to admit of being readily turned back, and thus allow of the capsule or cover being put on to a jar or bottle with great facility, and by turning down the piece of india-rubber tubing it is made instantly to embrace that part of the jar, bottle, or aperture to which the capsule-cover has been applied. The binding or grip of the india-rubber tube will be tight or slack upon the neck of the bottle according as the interior diameter of the elastic tube is less than that part of the jar or bottle to which it is applied and may be regulated also by the thickness of the rubber employed.

The principle of this invention is highly ingenious and susceptible of very wide application. That the junction may easily in this manner be made perfectly air-tight is attested by the general practice of connecting the joints and parts of laboratory gas apparatus by short lengths of vulcanized rubber tubing. Capsule lids formed entirely of india-rubber have been found to answer well for closing the mouths of jars and wide-necked bottles. It must be borne in mind that metallic specimens and many chemical products are liable to become quickly tarnished by exposure to the sulphuretted volatile emanations which continually escape from ordinary vulcanized india-rubber; in such cases the employment of the new capsule covers would necessarily be inappropriate.

335. *The Manufacture of Sub- or Oxy-Sulphate of Lead.* A. Leidemann and T. Lange, Newcastle-upon-Tyne. A Communication. Dated February 9, 1861.

For the purposes of a white lead paint the patentees claim the production and use of white precipitates containing sulphate of lead in combination with different proportions of oxide of lead.

Provided that the pigments formed in this manner be found to possess the requisite degree of body or opacity, this treatment would very likely be found serviceable in the working up of the precipitated sulphate of lead which is obtained as a bye-product in the process of making acetate of alumina mordant from alum and sugar of lead.

337. *Artificial Leather.* E. Gervaise and J. E. Bernier. Dated February 11, 1861. (Not proceeded with.)

The mode of manufacturing artificial leather is as follows:—The inventors propose to employ caoutchouc, gutta-percha, or other gums, fusible materials and substances. These are to be submitted to a sufficient degree of heat to liquify them, after which they are mixed either with cow-hair, wool, or vegetable fibres, and when desirable with waste pieces of leather or cuttings of skins. Pitch, tar, and certain oils may be substituted for the gutta-percha and india-rubber. When required to possess the greatest degree of strength the artificial leather should be subjected to the action of super-heated steam during the operation of incorporating the materials; and after perfect combination has been effected in this manner, the mass,

whilst in a warm state, is passed between pressure rollers to agglutinate the fibres and give it the required thickness, after which the material undergoes a final operation for imparting to it the appearance of natural leather. To effect this, the surface has to be coated with a varnish composed of solution of india-rubber or gutta-percha, gums, or drying oils, and is again passed between pressure rollers.

The manufacture thus described is very similar in its main features to that followed in the preparation of "American cloth," and also to that of "Clark's patent waterproof felt," which latter appears to be composed of cotton-wool matted together with gutta-percha, applied in a coal-tar naptha medium as a paste or solution in order to facilitate the incorporation of these ingredients. The success of such a process as that defined in the specification will mainly depend upon the careful selection of the raw materials, both gums and fibres, employed in the manufacture.

358. *Manufacturing a Glutinous or Viscous Substance to be Used in Dressing Textile Fabrics, and for other such like Processes, or in Brewing and Distilling.* W. Maltby, Camberwell, Surrey. Dated February 12, 1861.

In carrying out this invention the patentee takes ground rice and mixes it with about one-third of its weight of water, the temperature of which he prefers to be moderately warm. He now leaves it to stand for several days, with occasional stirring, until fermentation has commenced; then dries it with the assistance of artificial heat, which he regulates accordingly as the product is required to be more or less glutinous. The dry material resulting is ground to powder, and after mixing with hot water is ready for use.

The description above given, refers precisely to the ordinary method of preparing dextrin by fermentation. A process in common use consists in allowing to ferment starch, either in the form of damaged wheaten flour or ground rice, whichever may happen to be cheapest in the market at the time, simply mixed with water, and then left until fit for use, without resorting to any intermediate drying process.

365. *Refining Malt Liquors.* C. S. Roskilly, Falmouth. Dated February 13, 1861.

The patentee employs a mixture of malt, hops, the leaves of ground ivy, and nettles, boiled in water, and when cold he adds a small quantity of the decoction to the liquor to be refined.

The mucilaginous constituents of the two plants last named, would probably operate like gelatine in causing the more rapid precipitation or subsidence of the suspended impurities always present in malt liquors before refining.

Grants of Provisional Protection for Six Months.

1705. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improvements in the construction and arrangement of apparatus for the manufacture of ice, and for the refrigeration of solid and fluid masses in general."—A communication from Edouard Blée, Rue d'Amboise, Paris.—Petition recorded July 4, 1861.

1845. Nicholas Etienne Dumesnil, Rue aux Loups, Sotteville-les-Rouen, France, "Improvements in materials for lubricating parts of machinery and for other lubricating purposes."—Petition recorded July 23, 1861.

2029. Stephen Carey and William Morgan Pierce, Animal Charcoal Works, East Ham, Essex, "Improvements in apparatus for reburning animal charcoal."—Petition recorded August 15, 1861.

2067. Richard Archibald Brooman, Fleet Street, London, "An improvement in preserving meat and other animal substances."—A communication from Jeane Pierre Liès-Bodard, Strasbourg, France.

2077. George Frederick Muntz, French Halls, Birmingham, "Improvements in apparatus for melting metals."—Petitions recorded August 20, 1861.

2083. William Clark, Chancery Lane, London, "Improvements in optical and illuminating apparatus."—A communication from William Ferdinand Count de Douhet, Boulevart St. Martin, Paris.

2103. Thomas Richardson, Newcastle-upon-Tyne, and Robert Irvine, Hurlet, Renfrewshire, "Improvements in the manufacture of paper."—Petition recorded August 22, 1861.

2129. William Edward Newton, Chancery Lane, London, "Improved machinery for filtering liquids, decolourising saccharine and other juices, and rectifying alcoholic liquors."—A communication from Horatio Nelson Fryatt, Belleville, New Jersey, U.S.—Petitions recorded August 26, 1861.

Notices to Proceed.

1084. Robert Laing, Ince, near Wigan, and Israel Swindels, Wigan, Lancashire, "Improvements in the treatment of certain ores containing metals, and in obtaining products therefrom."

1109. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "The manufacture of paper and cardboard from a fibrous vegetable matter not hitherto used for that purpose."—A communication from Edmond Nuewens, Montreuil-sous-Bois, France.

1115. James Alexander Manning, Inner Temple, London, "A mode or method of collecting ammonia from the waste gases arising from the combustion of coal."

1131. Joseph Victor Vignon, Dean Street, Soho Square, London, "A mode of preparing or making enamel applicable to various purposes."

1217. William Clark, Chancery Lane, London, "The treatment of ammoniacal waters resulting from putrified urines, and from products extracted by the distillation of coal."—A communication from Messrs. Louis Joseph Frédéric Margueritte and Alfred Lalouël de Sourdeval, Paris.

1223. William Clark, Chancery Lane, London, "Improvements in the manufacture of steel."—A communication from Messrs. Louis Joseph Frédéric Margueritte and Alfred Lalouël de Sourdeval, Boulevart St. Martin, Paris.

1705. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improvements in the construction and arrangement of apparatus for the manufacture of ice, and for the refrigeration of solid and fluid masses in general."—A communication from Edouard Blée, Rue d'Amboise, Paris.—Petition recorded July 4, 1861.

1800. Sir William O'Shaughnessy Brooke, Westminster, "Improvements in apparatus for suspending and insulating electric telegraph wires."—Petition recorded July 17, 1861.

2029. Stephen Carey and William Morgan Pierce, Animal Charcoal Works, East Ham, Essex, "Improvements in apparatus for reburning animal charcoal."—Petition recorded August 15, 1861.

CORRESPONDENCE.

Phosphate of Sesquioxide of Iron.

To the Editor of the Chemical News.

Sir,—Since attention is directed in your columns of September 21, to the manufacture of phosphate of iron, and of the probable use to medicine which will follow its production, I thought it would be well to inform your readers that the phosphate of sesquioxide of iron was made for use in medicine by my friend Mr. John Lightfoot, chemist, of Broad Oak Print Works, Accrington, more than two years ago, and that its use was attended with success. Soon afterwards the above-named gentle-

man made a phosphate corresponding to the magnetic oxide, which is very freely soluble in citric acid and the neutral citrate of ammonia. This phosphate of protosesquioxide of iron has been used ever since by a surgeon in that town with marked success, in cases of albuminous and saccharine urine, and some forms of heart disease, and I have been told that Dr. Simpson, of Edinburgh, and several other medical gentlemen are in the habit of prescribing it.—I am, &c. W. R. BOOTH.

Chemical Notices from Foreign Sources.

TECHNICAL CHEMISTRY.

Processes for the Consecutive Preparation of Saltpetre, Potassio-tartrate of Soda, a pure Bitartrate of Potash, Tartaric Acid, and the Sulphates of Soda and Potash.—Guido Schnitzer gives (*Gewerbeblatt aus Würtemberg*, 1861, No. 15) the following as an easy and convenient way of obtaining the above salts. He starts with equivalent weights of Chili saltpetre (nitrate of soda) and rough pot ashes which he heats, with just enough water to dissolve them, in an iron vessel, stirring well all the time. When the mutual decomposition which ensues is complete, he adds to the boiling liquid sufficient milk of lime to convert the carbonate into caustic soda. The solution containing the nitrate of potash and soda is then evaporated for the nitrate of potash to crystallise out, which the author says it does completely. The crystals are then drained from the soda solution, and washed with water slightly acidulated with hydrochloric acid, to remove the last traces of soda.

The soda solution is then used for the preparation of the double tartrate of potash and soda. For this purpose it is boiled with sufficient rough tartar to make a neutral solution. This operation is best conducted in a copper vessel. A deposit of some tartrate of lime from the rough tartar remains, which may be carefully washed and used in the subsequent process for making tartaric acid. When filtered from this deposit, the solution is evaporated for crystals of the potassio-tartrate.

When the author wishes to prepare pure bitartrate of potash, he takes the filtered solution of the double tartrate as above, and adds sufficient hydrochloric acid to combine with the soda, whereupon the bitartrate of potash separates in small granular crystals, which are drained and washed with cold water to remove any chloride of sodium.

To make pure tartaric acid, the author takes the solution of the double tartrate as before, and boils it with gypsum free from iron, whereby tartrate of lime and the sulphates of potash and soda are formed. The tartrate of lime is decomposed by sulphuric acid in the usual manner, and then (any iron having been removed by the alkali) the tartaric acid is obtained quite pure in the first crystallization. The sulphates of soda and potash are afterwards separated by crystallization.

Preparation for Gilding Porcelain.—This preparation, the invention of the Brothers Duterte, is reported on by Salvétat (*Bulletin de la Société d'Encouragement*, &c. March, 1861, p. 129). The peculiar advantage of it is, that after burning, the gold is so bright as not to require polishing. Thirty-two grammes of gold are gently warmed with 128 grammes of nitric acid, and the same weight of hydrochloric acid. To the solution are added 1·2 grammes of tin and 1·2 grammes of butter of antimony, and when all are dissolved, the solution is diluted with 500 grammes of water.

A mixture is now prepared by heating together 80 grammes of oil of turpentine, 16 grammes of sulphur, and 16 grammes of Venice turpentine. When the sulphur is dissolved, 50 grammes of oil of lavender is added. The gold solution is now added, and the two are well stirred together until the aqueous solution becomes decolorised, showing that all the gold has united with the balsam. The watery portion is then poured away, and the oily fluid is washed with warm water, and then heated. When the last trace of moisture has disappeared, 65 grammes more lavender oil, and 100 grammes of oil of turpentine, are added, and the whole warmed to ensure the perfect admixture. While quite fluid, 5 grammes of subnitrate of bismuth are added. Afterwards, the clear part is decanted from any reduced gold and other insoluble matters, and the balsam is concentrated to a fit consistence for painting with. The balsam so prepared is a thick fluid of a pale green colour, the gold being perfectly dissolved; when proper care is taken to remove all moisture this preparation never blisters in burning.

MISCELLANEOUS.

The Polytechnic Institution.—We have already announced that Mr. Pepper has returned to the Direction of the Polytechnic Institution under the most favourable auspices. In his inaugural address he was greeted with a hearty welcome; he stated that although three years had intervened since he last appeared on that platform, the warmth of his welcome made him feel that the separation which had taken place between him and the Polytechnic audience was but then of yesterday. It made him feel that he was among friends, and he would appeal to them to aid him in the arduous duties he had undertaken. He said arduous duties, because when amusement, in its most attractive form, but totally devoid of rational instruction, was offered in other places to the public, it required no small degree of energy to manage an educational establishment in such a manner as to counteract the evil influences of the establishments to which he alluded. He would especially appeal to them to aid him, as they had aided his predecessor, Mr. Pheué, by sending works of art and art manufacture to the institution for exhibition, and so increase its attractions. It would no doubt be interesting to the public to know that the Rev. J. B. Owen was chairman of the board of direction, and that the Rev. Chas. Mackenzie had taken charge of the educational classes. We understand that it is the intention of the directors of the Institution to issue honorary admission tickets, transferable, to all the eminent scientific men of the day.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business Communications* to the PUBLISHER at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

The Water Supply of London.—Mr. John Frederic Bateman writes to correct the announcement made by Mr. Fairbairn in his address to the British Association respecting a scheme for supplying the metropolis with water from Wales, in which he is represented as having estimated the cost of bringing water to London from the Bagshot Sands at £12,000,000. This is altogether a mistake, arising mainly from a typographical error in a return to an order of the House of Lords in 1852. The scheme which Mr. Bateman laid before Lord Shaftesbury in that year, and which was included in the return referred to, was one for bringing the soft waters—not of the Bagshot Sands—but of the Green Sands in the neighbourhood of Hindhead and the Leith Hills, and this estimate was £11,200,000, not £12,000,000, as erroneously printed in the Parliamentary return. In a subsequent part of the same return, p. 36, the estimate is correctly given.

W. P. W.—We are not aware that any special experiments have been made with the object of producing alums, in which sulphates of any of the organic alkaloids are caused to replace sulphate of alumina.

Omega.—A full account of the spectroscope will be found in No. 149 of the *Photographic News*, for July 12, 1861, or it will be forwarded on application to Spencer, Browning, and Co., 111, Minories.

Carmine of Indigo.—A correspondent wishes to know the best way of preparing the above.

THE CHEMICAL NEWS.

VOL. IV. No. 96.—October 5, 1861.

THE PRESERVATION OF BUILDING STONE.

THE following Report has been addressed to the Right Hon. William Cowper, M.P., Chief Commissioner of Works, &c. We propose next week to give an analysis of the different projects for the preservation of stone which have been brought before the notice of the Committee.

We, the undersigned, being the Committee appointed "to inquire into the decay of the stone of the New Palace of Westminster, and into the best means of preserving the stone from further injury," have the honour to submit to you the following Report, in which we have adopted as the objects of our inquiry the several points referred to us by your letter of appointment and instruction, viz.:—

"I. The extent and position of the decay.

"II. The causes to which it is attributable, taking into consideration the composition of the stone, and the influence exerted upon it by moisture, and by the acids diffused in the London atmosphere.

"III. The best means of preserving the stone from further injury.

"IV. The qualities of the stones to be recommended for future use in public buildings to be erected in London."

1. In proceeding with the important inquiry thus intrusted to this Committee, we beg to state, that we first made a careful inspection of the whole of the buildings; and that after this inspection we proceeded to obtain such evidence as appeared to us best calculated to facilitate the inquiry intrusted to us, by examining a considerable number of witnesses who had been connected with the building from the commencement, or who had been concerned in the various processes which had been actually tried for arresting the decay which had occurred; and also another class of witnesses, who had suggested various theoretical remedies for the same purpose.

2. We delegated to a Sub-Committee, specially appointed, an examination and inquiry into the condition of other buildings erected in the metropolis, in which magnesian limestone had been used; and we particularly called the attention of the scientific chemists who had been appointed on the Committee to several points peculiarly within the limits of their acquaintance with chemical subjects.

3. We also considered it expedient to invite by advertisement the attention of chemists and others to the subject submitted to the Committee, requesting that any plan or suggestion for the prevention of decay, or for arresting its progress, might be brought under our notice.

4. Having thus premised the course the Committee thought it expedient and desirable to take, we now proceed to report *seriatim* on the subjects brought under our notice by your instructions, and in the order adopted therein.

I. *The Extent and Position of the Decay.*

5. It is extremely difficult to give any very exact account either of the extent or actual position of the decay. It seems from the evidence that it first began to make its appearance in the portions of the Palace at Westminster executed at the commencement of the building, about seven years after their execution; and yet, in some of the most recently executed portions, viz., those towards Old Palace Yard, facing Henry the Seventh's Chapel, the decay appears to be as obvious as in any other part of the building.

6. In the earlier works, viz., those towards the Thames, the decay is most apparent in the lower portion of the building, and in this portion the decay is confined to what may be called "zones," or general levels, which would seem to suggest that it depends as much upon position in the building as upon the use of particular beds of stone from the quarries employed.

7. The same remark applies to the part of the Palace fronting the approaches to Westminster Bridge, where the decay of the lower portion is considerable; but in the newest work, facing Henry the Seventh's Chapel, the decay occurs in positions which are more varied, and under circumstances which it is exceedingly difficult to appreciate.

8. We have examined with much care the upper portions of the building, and we cannot perceive that the decay has made any important inroad upon those much more exposed portions, where decay might more reasonably have been expected. The decay, however, occurs again to a considerable extent in the inner courts, which are sheltered in a great measure from external influences; and perhaps the very worst specimen we have noticed is to be found in the small archway leading to the reporter's gallery, near the entrance to Westminster Hall—a part of the work as much sheltered as in the nature and circumstances of a public building it could well be.

9. The general result of our observations, confirmed by the evidence, would seem to suggest that the stone used in the Palace of Westminster is much more likely to decay in damp and sheltered situations than where it is exposed to the full action of atmospheric influences. In the east and north fronts, before adverted to, the worst symptoms occur in the ashlar between the upper and lower mouldings of the plinth, and under the first cornice, where the exposure is inconsiderable; but the dampness, arising from the drip of the mouldings and from the action of capillary attraction, in cases where projections hold the moisture, appears to exercise an important influence on the condition of the stone itself.

10. It does not appear to us that the decay is attributable, as is commonly supposed, to the stones in the building not being placed upon what is technically called their natural bed, or in the same relative position as they occupied in the quarry; thus, stones which are found horizontally in the quarry, appear to have been often

placed perpendicularly in the building, and used for purposes of the most delicate decoration without any injurious result. As an instance of this fact, we may point out the elaborately carved shields of arms under the range of the first-floor windows; the stones used for those shields, though universally placed perpendicularly to their natural position in the quarry, present, so far as we are aware, few, if any, symptoms of decay.

11. The extent to which the decay on the whole surface has proceeded, it is not very easy to estimate. At the present moment the actual decay is doubtless considerable for a building so recently erected; but the change of colour in the stone itself, and the "fretting out of the surface," which are suggested as the first symptoms, lead us to apprehend that there may exist much more mischief than at present is actually apparent.

12. One of the witnesses examined, however, and whose judgment as a practical man is of considerable value, is of opinion that the decay, after proceeding to some depth in the stone, stops of itself; that an induration of the surface takes place, and that no further decay ensues. The Committee would willingly accept this opinion if they considered it well founded, but they cannot conceive that it is true to any considerable extent, notwithstanding there may certainly be some few indications which lead to the belief that in some cases it may be correct.

13. At present the decay appears for the most part on the plain surfaces, whilst the finer and more elaborately wrought portions of the building, unless under projections, are not seriously affected. And however disappointing and disfiguring these defects may be, especially in a building so recently erected, the Committee are of opinion that at present the decay does not affect the stability of the structure.

II. *The Causes to which the Decay is attributable.*

14. This part of the inquiry naturally leads to a reference to the evidence which has been obtained by the Committee on the subject of the stone itself. The result of this evidence may be thus briefly stated. The stone recommended by the Commissioners for this building was that from the quarries of Bolsover Moor and its neighbourhood, and this stone was actually contracted for in the first instance. Before the work began, however, it was found that blocks of sufficient size could not be procured from those quarries, and, in consequence, one of the Commissioners was appointed to proceed to the spot, to ascertain whether other quarries might not be discovered furnishing stone in beds of greater thickness and of larger dimensions. These conditions were found in the quarries of Anston, and the stone of greater thickness produced from these quarries has been used not only in this building, but in all the other buildings constructed of magnesian limestone in the Metropolis, after the quarries of Bolsover Moor had been abandoned, for the reason above stated.

15. The recommendation of the Bolsover stone in the Report of the Commissioners was founded on its similarity to that used in the Norman portions of Southwell Minster, which were stated in the Report to be in a high state of preservation. Evidence has since been adduced, in a letter from Mr. Scott, to be found in the Appendix, which renders it probable that the stone of this Minster was really obtained from the ancient quarries at Mansfield Woodhouse. The latter quarries were re-opened, and a considerable quantity of stone from them (exceeding 20,000 cubic feet) was made use of in the Palace at Westminster; but in their turn they were relinquished from dissatisfaction as to the size of the blocks, though we have it on evidence, confirmed by our own observation, that the stone used from these quarries has stood remarkably well.

16. The evidence brought before your Committee on the subject of the stone obtained from the Anston quarries is very conflicting; the contractor and his principal foreman stating that the stone was, with slight exceptions, extraordinarily good, while other witnesses maintain that, even in the quarries themselves, there are stones in a state of actual decomposition; and one very important witness, a foreman employed at the Palace at Westminster, asserts that he knew that certain beds in some of the quarries were liable to decay, and that he abandoned them in consequence. With reference to the selection of stone, the Committee venture to remark, that it is much to be regretted that the offer made by one of the Commissioners particularly well acquainted with the selection and working of stone, to examine that used in the Palace at Westminster for the moderate salary of 150*l.* per annum was not accepted, owing to some difficulty in regard to the party who was to be held responsible for this unimportant amount; and that the matter was left to persons who admit that they had little or no prior experience of this description of stone, though they evidently entertained suspicions of the durability of some of it which they were employing.

17. With reference to the very natural and important question of the actual causes of the decay of this stone when exposed to the London atmosphere, the Committee take the liberty of referring to the Report of the chemists who were members of the Committee to whom this question was specially referred. This will be found in the Appendix.

III. *The best Means of Preserving the Stone from further Injury.*

18. This part of the inquiry referred to the Committee naturally divides itself into two questions: namely, as to the steps that have hitherto been taken, whether experimentally or otherwise; and as to those that are to be recommended for adoption hereafter. With regard to the first question, we have ourselves examined with care the result of what has been done at the Palace itself, either experimentally on the river front, or, as in the inner courts, by actual coatings or washings over large surfaces. With regard to the second question, our inquiries have been earnest and elaborate, and we have examined many witnesses and given much time to the consideration of the various propositions obtained by advertisement or otherwise. As will be seen in a subsequent part of the Report, we finally referred this question to the further consideration of the professional chemists who were on the Committee.

19. On the first question, the Committee are decidedly of opinion that it is not necessary nor desirable to proceed with any general coating, painting, oiling, or washing of the whole building. It is quite obvious, in their judgment, that a very large proportion of the stone does not require any such application; but that what is wanted is some efficient process which should be applied to the surface of any stone that begins to show symptoms of decay, with a view to arrest its progress. The Committee believe that the persons to whom the care of the building is entrusted ought to watch it, and note in the very earliest stages wherever decay is perceptible, by efflorescence, change of colour, crumbling, or slight decomposition.

20. In cases where the decay is important, and evidently occasioned by the fall of rain on an upper projecting or exposed surface, protection should be afforded by a covering of sheet zinc or lead; and if hereafter any composition should fortunately be discovered, by which the decaying stone could be at once covered or coated, and the injurious influences of the atmosphere prevented from further acting upon it, the difficulty would be solved. In some extreme cases the decayed stone might be cut out, and replaced by a new one. With regard to the processes which have actually been applied, whether experimentally or extensively, your Committee are decidedly of opinion that the discovery of a proper mode of treating stones in a state of decay has not yet been made, and there is no evidence whatever on the building itself to induce them to believe that the decay, where decay has arisen, has been arrested, or that permanently the decay has been prevented by any of the processes yet applied.

21. With reference to the second question, we found ourselves unable, after much labour, to come to any definite conclusion; and we finally requested the chemists in the Committee to examine and report upon it; but those gentlemen state, as appears by their Report in the Appendix, that the nature of the inquiry is so extensive, and that time is so important an element in the solution, that they are unable to give any opinion upon the subject. They further state, that they spent five whole days in the examination of only one suggested remedy, but they are unable, notwithstanding, to give any opinion on even that one suggestion. They allude to secret processes, regarding which they say they can offer no opinion, but they express a doubt of the applicability of any suggestion which would demand the veil of secrecy for protection. Concurring in this view, it may be further noted that even if such applications were found successful in sample or experiment, no security would be afforded for a corresponding success in any subsequent large operations. They recommend that a series of experiments should be conducted under chemical supervision for a considerable period of time, and the Committee are most reluctantly compelled to coincide with them, and to urge upon the Government the adoption of such a course.

IV. *The Qualities of the Stones to be recommended for future Use in Public Buildings to be erected in London.*

22. On this head of the inquiry the Committee have been unable, in the time allotted to them, to go into any very extensive examination. It is obvious, however, that although some varieties of magnesian limestone are an excellent and durable material, when not exposed to the deleterious influences of the London amosphere, yet that in London it is subject to causes of decay, which render it an undesirable and unsafe material for the construction of public buildings.

23. It is equally obvious that Portland-stone, well selected, has been used in buildings in London from the date of St. Paul's downwards, under circumstances of great exposure, and with most successful results. Portland stone is a material to be obtained in any quantity, and in blocks of any size, beautiful in colour and texture, reasonable in price, not by any means so hard as the Anston stone, and yet with a power of resisting the influences of the London atmosphere, that leaves but little to be desired. It must be remarked, however, that Portland stone should be carefully selected, an operation which would be the most satisfactorily effected by an agent at the quarries.

24. On this subject the Commissioners could of course bring much personal experience to bear; but after the valuable explanation of the principles upon which the decay of stone depends in populous places as given by the Chemists, in their Report before referred to, the Committee refrain from repeating those conclusions, in which, however, they entirely concur.

25. During the inquiries of the Committee, one of their members, Mr. Burnell, who is well acquainted with architectural and engineering works in France, undertook, at his own expense, a journey to Paris, to inquire into the practice of the French architects engaged in the Government works in that metropolis. There, the stone used, the "calcaire grossier," though a carbonate of lime of tertiary age, and, therefore, of very different mineral composition from our magnesian limestone of the much older Permian age, seems to suffer also from decay in a comparatively pure atmosphere, and where wood is chiefly used as fuel.

26. From the evidence of Mr. Burnell, it does not appear that French architects or chemists have been more successful than ourselves either in the use of materials not subject to atmospheric influences, or in the application of processes for arresting decay, when it has once begun. The opinions of the most scientific chemists and architects in France on this subject have, however, in this way been obtained, and it is extremely probable that the inquiries undertaken by them, simultaneously with those undertaken in this country, may hereafter lead to some successful result.

27. The Committee have to thank the Government for the facilities given to Mr. Burnell in this important part of the inquiry, by providing him with an introduction which obtained for him the active assistance of Her Majesty's Ambassador at the Court of the Tuileries.

28. The Committee delegated, as before stated, to a Sub-Committee the duty of examining the various buildings in London in which magnesian limestone from the Anston quarries has been introduced in the external architecture. The Report of this Sub-Committee forms part of the Appendix; and we beg to refer to that Report as confirmatory of our opinion of the uncertain character of magnesian limestone, and the risk attending the use of it in London.

29. In conclusion, the Committee venture to recommend that the architect of the Palace at Westminster, assisted by scientific chemists, should examine and record the actual state of the stone work of the building at the present moment; that experiments should be made by their direction, under various conditions of height, exposure, and aspect, with such preservative materials and agents as the chemists may suggest from time to time, and that researches should be continued into the effects of the various alkaline silicates, the phosphates, and other substances which have been brought under the notice of the Committee, or suggested in Germany, France, or elsewhere; that where decay arises from damp, means should be taken to protect the stone, as has been before suggested; that any stone extensively decayed should be removed and replaced; but that in particular the earliest symptoms of decay should be carefully watched, and examined with the view to the application of some immediate remedy. The Committee believe that a very large portion of the stone in the Palace at Westminster is of a very durable nature, and they entertain a confident expectation that a remedy will soon be found to arrest or control the decay when it has unfortunately begun to appear.

William Tite,	Rod. I. Murchison,
Sydney Smirke,	George Gilbert Scott,
George Godwin,	M. Digby Wyatt,
A. W. Hofmann,	E. Frankland,
F. A. Abel,	James Tennant,
George R. Burnell,	Thomas Hawksley,
Charles H. Smith,	Edward M. Barry.

Alfred Bonham-Carter, Secretary.

The following letters have been addressed to the Chairman of the Committee on the Decay of Stone of the New Houses of Parliament :—

June 17, 1861.

Sir,—We have the honour to inform you that we have complied with the wishes of the Committee by examining into the several proposals which have been laid before them for the preservation of the stone of the New Houses of Parliament; and that we have arrived at the following conclusions :—

1. Amongst the processes proposed, varying in principle and value to a very considerable extent, there is not one which we at present feel justified in proposing that the Committee should definitely recommend as a preservative, either for general or local application.

2. A minute examination into one class of processes, submitted to the Committee at an early period, has convinced us that, surrounded with great difficulties as the subject appeared at the outset, the obstacles eventually met with in an effective experimental inquiry are of a far more formidable character than could have been anticipated. Having devoted five days exclusively to the practical study of one of those processes (Ransome's), and having been unable, in that period, to elaborate even this single process sufficiently to warrant us in expressing a definite opinion upon its merits, it is obvious that anything like an elaborate examination of the numerous proposals which have only just now been submitted to us, would require the expenditure of a far greater amount of time than the Committee could place at our disposal.

3. Whilst regretting that it is not in our power to lay before the Committee a positive recommendation of any particular process, we beg to submit the following observations :—

An examination into the nature of the several processes proposed leads to their classification, under two heads :—

(*a*) Processes which are likely to afford permanent protection to the stone.

(*b*) Processes which are only calculated to afford protection of a temporary character.

In both of these classes there are proposals which may at once be excluded from further consideration, on account either of their inapplicability to stones when placed in a building, or of the obvious misapprehension, on the part of the proposers, of the problem to be solved.

A proposal to protect stones by immersion in a boiling mixture of pitch or resin and oil, may be quoted in illustration of the processes which are only applicable to stones previous to their having become integral parts of any structure; again, the suggestion to cover the building with a coating of a mixture of silica with sulphur, applied in a semi-fluid condition, would involve almost insurmountable difficulties in its practical application, not to speak of the inflammability of the sulphur, which is only slightly diminished by the presence of the silica, or the uncertainty of the temporary character of the protection which, even under the most favourable circumstances, could be afforded by this material.

Several of the suggestions are based upon notions so obviously erroneous, such as coating the building with sulphate of lead, and procuring an alleged galvanic protection, by establishing connections of this coating with plates of zinc; or, of ridding the building of the principle of decay by fermentation, that no object whatever could be gained by entering more fully into the merits of these proposals.

Of the processes which are intended to afford permanent protection to the stone, and the use of which is not precluded by the conditions of the case, there are several which claim a careful investigation. These processes may be classed under the following heads :—

1. Application of silicates of the alkalies, in various states of concentration.

2. Application of silicates, in conjunction with various saline compounds, intended to produce double decomposition.

3. Application of hydrofluoric, or hydrofluo-silicic acid, or their saline compounds.

4. Application of phosphoric acid, and acid phosphate.

5. Application of solutions of the alkaline earths, or their bicarbonates, in water.

All these processes are more or less based upon chemical considerations, which are supported by analogy, and which, in the case of the two first-named classes, have received considerable experimental confirmation. The experiments which are now in progress with several of the processes included in the two first subdivisions will, we believe, in the course of a few years, furnish ample data for correct conclusions regarding their applicability. In the meantime it might be advisable to apply to portions of the New Houses of Parliament actually undergoing decay, certain processes selected as representatives of the remaining classes above enumerated, in order that their merits might be submitted to the only conclusive tests, those of actual application, and protracted exposure to the corrosive influence of a London atmosphere.

The second division of processes,—namely, those which are only calculated to afford protection of a temporary character, are, from their very nature, of minor importance for the purposes of the Committee's inquiry; nevertheless, as the claims to permanence of none of the processes of the first division have as yet been substantiated by the test of time, we would recommend that, in addition to the experiments already made in this direction, further trials be instituted of some of the more promising materials of this particular description. This recommendation is based upon the consideration that substances, included under the appellation of organic, differ essentially in their powers of resisting the destructive action of the atmosphere. Whoever is acquainted with the nature of organic substances, cannot fail to appreciate the different degrees of stability under atmospheric influence exhibited by glutin, gelatin, or starch (which we find enumerated among the proposed protective agents), and by bees-wax and paraffin, not to speak of many of the fossil gums, which exhibit a degree of permanence approaching that of mineral substances.

The materials which we would recommend for selection to be tried in comparison with linseed oil, are paraffin, bees-wax, and some of the more permanent gums and resins, applied in the form of solutions in volatile solvents.

We should not omit to remark, that some of the witnesses and others who have addressed the Committee, speak of secret processes. We cannot of course offer

any opinion regarding such proposals, but we should doubt the applicability of any suggestion which would demand the veil of secrecy for protection.

Finally, we beg to state, as the result of the experience which we have been enabled to acquire during the prosecution of our investigations on this subject, that a definite solution of the question at issue can only be arrived at after the lapse of a considerable period, since the relative merits of the processes which we recommend for trial can be established only by the test of time.

We have, &c.,

(Signed) A. W. Hofmann.
E. Frankland.
F. A. Abel.

(To be continued.)

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, *Member of the Royal Academy of Belgium.*

All the analytical researches undertaken for nearly a century past tend to show that compound bodies possess a definite, constant, and unvariable composition. The proportions deduced from these researches have been successively termed "Proportional numbers, chemical proportions, chemical equivalents, or atomic weights." The illustrious Berzelius devoted a great part of his life to settle the relative weights of these chemical proportions. His works on this subject remain imperishable monuments of his penetration and genius. The minute and reiterated control to which I have had the presumption, not to say the temerity, to submit them has convinced me that his analytical skill has never been surpassed—in fact, has never yet been equalled. Berzelius, it is known, concluded from his researches that no relation whatever existed between the atomic weight of bodies. He remained convinced of this fact all his life.

In 1815 Dr. William Prout, in a memoir entitled "The Relation between the Specific Gravity of Bodies in their Gaseous State, and the Weight of their Atoms," propounded the idea that the atomic weights of those bodies best ascertained at that time might be represented by multiples of the atomic weight of hydrogen. Prout had sufficient diffidence as to the correctness of his hypothesis to publish his work anonymously. Whatever may be the general opinion of this hypothesis, or whatever fate is reserved for it, it is impossible not to pay homage to the rare penetration of its author. True or false, matters not; it enabled him to divine the specific gravity of hydrogen forty years before it was determined in an almost absolute manner by experiment.

In a philosophical point of view the compass of Prout's idea is immense. In England this hypothesis has been very generally accepted as an absolute fact. The work published by Professor Thomas Thompson, of Glasgow, to support it by analytical experiment, contributed much to this result. Yet it was not so in Germany and France. The immense *prestige* which surrounded the name of Berzelius, and the great confidence which his works upon atomic weights inspired, was undoubtedly the reason. Doubts even arose in England in 1833. Professor Turner, at the invitation of the British Association for the Advancement of Science, undertook a series of analyses, from which he came to the conclusion that the hypothesis or Dr. Prout was not correct. In 1839 Professor Penny, of Glasgow, arrived at the same conclusion, although his results differed in various points from these obtained by Turner. The determination that M. Dumas and the author made in 1839 and 1840 of the atomic weight of carbon again drew the attention of chemists to this subject. The carbon atom derived from the synthesis of carbonic acid, agrees entirely with the fundamental hypothesis of Prout. The new synthesis of water that M. Dumas made known in 1843, and which was confirmed by the works of MM. Erdmann and Marchand, lead to the same result. In 1842 and in 1843 M. de Marignac, of Geneva, undertook a series of experiments upon the atomic weights of chlorine, bromine, iodine, nitrogen, silver, and potassium, with the view of submitting Prout's law to a new and rigid examination. The Genoese chemist, whose accuracy is well known, and to whose ability and conscientiousness Berzelius paid the homage which they deserved, stated most positively that the unity taken by Prout was too great by one-half, as far as chlorine is concerned. But he stoutly declared, that, considering the extreme difficulty of arriving by experiment at absolutely accurate results, the atomic weights that he had found for silver, potassium, bromine, iodine, and nitrogen, should not be considered as contrary to Prout's law. Thus, according to M. de Marignac, the principle may be correct, only the unity ought to be lessened by one-half.

Towards the end of 1857 M. Dumas published a memoir "On the Equivalents of Simple Bodies." As might have been expected, this work produced a great sensation. The celebrated French chemist, relying upon the works of M. de Marignac on silver, found that all the well-known bodies which he had had occasion to examine obeyed perfectly Prout's law, provided this law were slightly modified. According to him, the simple bodies are multiples of hydrogen either by 1, or by 0·5, or by 0·25. My illustrious master accompanied his work by important considerations on natural philosophy, but which have no connexion with the question of which I intend to treat.

Such is the present state of our knowledge of the relations between the atomic weights of simple bodies.

For several years I have devoted all my leisure to elucidate this problem. I will say candidly, that when I undertook my researches I had an almost implicit confidence in Prout's law. The doubt that I expressed in my work on the atomic weight of carbon, published in 1845, being owing to the result of two determinations which would not agree with my other synthetical experiments. My investigations have been on chlorine, bromine, iodine, fluorine, sulphur, nitrogen, potassium, sodium, lithium, calcium, barium, lead, and silver. It will scarcely be credited that during the long and tedious work to which I had devoted myself, I obtained successively the most discordant results, according to the body and the means I employed. Sometimes these results agreed entirely with Prout's law, as, for example, in the case of lead, silver, sodium, and calcium defined in relation to the atomic weight of carbon; at other times they were thoroughly at variance with this law, as in the case of lead determined in relation to the atomic weight of nitrogen and sulphur; of silver determined in relation to nitrogen and chlorine; of potassium in relation to oxygen and chlorine.

I am able to state without fear of being contradicted, that every chemist who has devoted himself to researches on the atomic weights, if he has varied his methods of operating, if he has sought for the atomic weight of a body by referring it to the atomic weights of two or

three different bodies, has met the same obstacles and the same contradictions. The most tedious perplexities have in this way attended my investigations.

Although I have but lately made it known to the Academy, begging them to take note of my assertion, all doubt has since disappeared from my mind. I have acquired the most complete conviction, and the greatest certainty that man can feel on such a subject, that Prout's law, with all M. Dumas' modifications, is a mere illusion, an hypothesis absolutely contradicted by experiment. Chemists, after having examined the work which I have now the honour of presenting to the rigid scrutiny of the Academy, if they can divest themselves of their prejudices and their present ideas on the subject, and keep to experiment, will soon arrive at my conviction, which is—That no common divisor exists between the weight of the simple bodies which unite to form all definite combinations.

The present work only contains my researches on nitrogen, chlorine, sulphur, potassium, sodium, lead, and silver. I have chosen these bodies because they are well known; they give the most stable compounds, and are supposed generally to obey Prout's law.

I have sufficiently explained that the object of my work is not to determine the absolute atomic weight of these bodies, but only the relation between their atomic weights, so as to see if there exist among these relations a common divisor. I have employed methods which, to my mind, are likely to give the most certain results; and in varying the processes I have given the preference as much as possible to those which have been already used by chemists of well-known accuracy. In this way I have obtained the most valid results.

It is clear that if these results, repeated several times, agree with those previously obtained, the probability is in favour of their accuracy; if, on the contrary, they differed, I found, by studying attentively all the conditions of the experiment, the way to ascertain the truth. I have thus discovered errors which would otherwise undoubtedly have escaped me.

Although the end I had in view was to search for the relations between certain numbers, I have nevertheless made two determinations, both of which assist to deduce from all my experiments the atomic weight of the seven simple bodies in relation to oxygen. We shall soon see that the atomic weights are very similar to those generally accepted, with the exception of nitrogen.

The determinations of these relations have been made either by synthesis or by double decomposition. I have only had recourse to analysis to obtain the means of calculating the atomic weights in relation to oxygen.

Before giving a succinct account of my researches, I ought to explain for the extremely large quantity of material with which I have experimented These quantities may well astonish chemists. I did not, however, break through the established rules without due consideration. I can quote two precedents in the history of science:—M. Dumas, in his memoir on the composition of water, and M. de Marignac, in his work on the atomic weights of chlorine, nitrogen, and silver, previously employed large quantities of material. For myself, in my memoir on the atomic weight of carbon, published in 1845, I have increased tenfold the weight of the quantities usually employed. Up to the present time, as far as I know, no one has objected to this method of operating.

If we examine attentively the atomic weights which are generally recognised, and compare them with what they should be according to Prout's law, we shall soon see that they are separated by unimportant variations. Besides, if it were not so, the problem would have long been solved. But experiment shows that the only means of proving with certainty, and of measuring exactly, the small discrepancies, is by increasing the quantities which produce them, so as to make a great disparity between these errors and those of the experimenter, which must be deducted from them. It may be imagined that the difficulties of the researches increase with the increase of quantities. Those chemists who may take the trouble to verify my results in all the various stages, will soon perceive that this is not the case: the only real inconvenience resulting from the use of large quantities is the length of the experiment, which in some cases is increased in the same ratio as the quantity. But, in return, if they continue the experiment to the end, the result carries conviction with it, because it is susceptible of only one interpretation; whilst, by employing less quantities, one is always apt to regard slight variations in the experiments as due to the inevitable errors of manipulation. One remains in uncertainty; and besides that, truth sought is liable to be lost altogether.

In looking over works treating of the atomic weights, I have often regretted that all the details of the experiments are not stated. I have thus been deprived of the means of satisfying myself as to how far the results merited the confidence which has been given to them. Being desirous, therefore, in all that concerns the results of my own researches, to give to every one the means of verifying and correcting them if they desire to do so, I have, therefore, endeavoured to give in the present memoir a minute description of every condition through which my determinations have passed. For this reason I have described accurately the balance and weights which I used to weigh them, the methods employed to guarantee the exactitude of the weights, the materials and the vessels; and to preserve the identity of the weight of the vessels during and after the experiment, I have also mentioned the nature of the vessel in which each operation was made.

I commence by showing how I prepared the substances submitted to experiment, tho substances I made to react upon them, and lastly, the means employed to find the purity of each.

It is impossible to reproduce in this work a complete detail of my experiments; I shall therefore confine myself to the facts indispensable in appreciating the value of my researches, and the confidence which they should inspire.

(To be continued.)

On Tinkalzite (Borate of Lime and Soda) from Peru, by T. L. PHIPSON, *Phil. Nat. Doct. Bruxelles University, Member of the Chemical Society of Paris, &c. &c.*

THE useful mineral of which I am about to speak was discovered only a few years ago in the deposits of nitrate of soda in Peru. It is now imported into Europe in considerable quantities as a substitute for borax. It was first examined in 1850 by M. Ulex, who found that it contained boracic acid, lime, and soda; but the analysis published by this author shows too small a quantity of water and too much boracic acid. In 1859, M. Kletzinsky received some samples of this same mineral from the Western Coast of Africa, and the analysis he has made

of them coincides pretty well with my analysis of some specimens from Peru.

Tinkalzite is found in the layers of nitrate of soda of Southern Peru, in the shape of irregular globular masses, which the natives call "tiza," and which vary in size from that of a nut to that of a potato. The outer crust of these tubercules is rather hard, but they are easily broken, and are then seen to be formed, in the interior, of a mass of crystalline needles intersecting each other in all directions, and of a brilliant white, satiny appearance. Often these globular masses contain reddish crystals of gypsum and other minerals; and they always contain a certain quantity of common salt, which gives to the mineral a brackish taste.

Water extracts from tinkalzite all its chloride of sodium and borax; acids easily dissolve the whole mineral, leaving only a small residue of very fine sand.

The density of tinkalzite I find to be 1·93 (according to M. Kletzinsky, = 1·9212; and according to M. Ulex the satin-like fibres, = 1·8). The analysis of the mineral in question has given me the following result, by the side of which I have placed the analysis of M. Kletzinsky:

	American Tinkalzite. Phipson.	African Tinkalzite. Kletzinsky.
Water	34·00	37·40
Soda	11·95	10·13
Lime	14·45	14·02
Boracic acid	34·71	36·91
Chlorine	1·34	1·33
Sulphuric acid	1·10	0·50
Silica	0·60	..
Sand	2·00	..
Phosphoric acid	Traces	..
Alumina	..	..
Magnesia	..	..
	100·00	100·00

The difference in the quantities of water, as shown in these two analyses, is owing to the gradual loss of water by soda-salts when exposed for some time to the air.

By neglecting the accidental elements and calculating the water, soda, lime, and boracic acid, we arrive at the formula:—

$$(NaO,2BoO_3 + 10HO) + 2\,(CaO,BoO_3 + 2HO) + 2HO.$$

Borax. Borate of lime. Water.

The presence of the other substances given by analysis seems to indicate that this mineral has been formerly deposited by mineral springs; and the fact that the biborate of soda it contains has crystallised with ten equivalents of water, shows that the temperature of these springs could not have been greater than + 55° Centigrade. As it is imported from America for industrial purposes, tinkalzite contains about 60 per cent. of borax, 25 per cent. of borate of lime, and 2½ per cent. of common salt. It forms an excellent flux for metallurgic purposes, and has been employed with success in the porcelain manufactory of Sèvres by M. Salvêtat. In fact, it appears capable of effectually replacing borax in all the applications of this rather expensive salt to industrial or manufacturing processes.

To extract boracic acid from tinkalzite a given quantity of hydrochloric acid is diluted with water and saturated, while boiling, with the pulverised mineral; the clear solution is decanted while hot, and upon cooling the liquid throws down the boracic acid in large quantities. —*The Technologist, Sept.*, 1861.

TECHNICAL CHEMISTRY.

The Deodorisation of Sewage at Exeter.

AT the last Monthly Meeting of the Local Board, Mr. Pince said, in addition to the report which he had to make, as Chairman of the Committee appointed to investigate the plan for disinfecting the sewage, he had received a very satisfactory letter from Mr. Margery, Engineer to the South Devon Railway, who said he had used the carbolic acid which Mr. Pince had supplied him with, with effect in horse-boxes and fish-vans. He had also received another letter from Dr. Kingdon, of the St. Thomas Lunatic Asylum, to whom a bottle of the disinfectant was sent, requesting him to use it in the most offensive parts of the Institution. The Doctor bore testimony to the high qualities of carbolic acid as a deodorising agent, and that having used it for some time he had found its effects to be instantaneous. In addition to these letters, he had to state that on Friday evening he attended, with Mr. Farrant and their Surveyor, at the depôt, and they had tested the sewage in the same kind of manner as other members of the Board had previously done. They proceeded to a place where there was a low level, and which was covered over with a thick scum. They scraped off a portion of this, and Mr. Farrant tested it. All of them smelt it, and nothing could be perceived but a rather pleasant smell of carbolic acid. That was highly satisfactory as far as Mr. Ellis and himself were concerned, and was fully confirmatory of the evidence adduced by the rest of the Committee. The letter of Mr. Farrant was to the effect that he had tested the sewage, as mentioned, and could not detect the slightest trace of noxious effluvia. He considered the present system of deodorisation most perfect. Mr. Ellis, the Surveyor, then read his report. Having stated that the three months proposed for the experiment of deodorising the sewage had expired, Mr. Ellis proposed to offer a few remarks on the subject:—

"The treatment of the sewage must necessarily be taken under two heads,—first, its disinfection, so as to render it free from smell and prevent it causing any nuisance; secondly, to utilise it, in order to make it remunerative to the Board. The average quantity of carbolic acid used per day, since its commencement, has been about one gallon, at a cost of 11d., diluted with lime-water in the proportion of about 1 in 250, and applied to the sewage about ten hours per day, Sundays excepted. The result, I have no hesitation in saying, has been most satisfactory. . . . . The action of the disinfectant on the sewage is not, as many suppose it to be, of a temporary character,—viz., to abate and destroy smells for a time only, but, on the contrary, the carbolic acid possesses considerable power to disinfect, through staying, or, rather, preventing decomposition, which prevents the sewage becoming putrescent and giving off offensive emanations, or again reverting to its former state; and when the sewage is once disinfected at the depôt, or in any part of the sewer, it matters little how long it takes passing off; decomposition cannot again set in, nor can any noxious gases be afterwards evolved in the atmosphere. Through the application of the disinfectant upon the sewage being previous to the commencement of decomposition, ammonia is not formed, but becomes locked up and preserved in the sewage, both in the liquid and solid state, which necessarily enhances its value very much in an agricultural point of view. This is of the utmost importance, as it also renders the sanitary

state of the atmosphere in the immediate neighbourhood where the sewage passes comparatively pure, the carbolate of lime having answered the purpose of disinfecting the sewage, during the past three months of summer, and by the use of, on an average, about one gallon of carbolic acid per day, at a cost of 11d., whilst the quantity required to produce the same effect in winter, with the atmosphere at a low temperature, would be about two-thirds that quantity. Thus, estimating six months of the year at one gallon per day, at 11d. per gallon, and say 1½d. per day for lime, would give a cost of 1s. 0½d. per day, or, for the six months, of 7*l.* 10s.; whilst for the remaining six months the price will be 5*l.*, giving the cost of the disinfectant for one year at 12*l.* 10s. The superintendence of the man, at 10s. per week, interest on outlay, and wear and tear, say 1*l.* 10s. per annum, will give a total of 40*l.* per annum. . . . . The disinfecting being satisfactorily overcome, the next and very important part, that of utilising the sewage and rendering it remunerative to the Board, requires attention. First, in order to utilise the sewage, it is of course necessary to procure the assistance of the owners of the property through which the sewage passes; and were they sufficiently acquainted with its value, it would not have flowed to waste so long unheeded; but as prejudice is frequently a barrier to improvements of this kind, it necessarily becomes a work of time to undertake and carry it out, however much its merits are known and appreciated. And previous to the application of the disinfectant several objections offered themselves in preventing its being undertaken as a whole, which now no longer exist: First, from the land immediately below the depôt, and through which the sewage passes, belonging to several owners, some difficulty was experienced in obtaining the sanction and assistance of the whole; but there would be no difficulty in that respect, as the whole may now be taken by Lord Devon and Sir Lawrence Palk, who are, I believe, both favourable to the scheme. Secondly, before the sewage became disinfected, it was thought necessary to apply the whole of it to the land at all times of the year, but which is now indispensable, as at certain times of the year the sewage, when disinfected, might be allowed to pass down the course, as at present, and be carried off without any additional expense than that of disinfecting, which would be self-acting. Thirdly, another important advantage offers itself, which is the increased value of the sewage, after being disinfected, by locking up and retaining its manurial qualities until absorbed by the soil. . . . . I believe no difficulty whatever would be experienced in getting a sufficient number of shares taken up by practical persons who have long since perceived the desirability of facilitating and grappling with a question so considerably discussed and possessing such national interest,—viz., that of returning to the soil those beef-growing properties which are well known to exist in the sewage of our towns, instead of allowing it to empty into and pollute our rivers. As such a step would, in my opinion, be a stepping-stone to the utilising the whole of the sewage of Exeter, as I have no doubt but that our neighbours on the opposite side of the Exe will, at no very distant period, not only from the interest they will feel in improving the sanitary state of the neighbourhood where their sewers empty into the river, but also to recognise and remedy the great agricultural waste which at present exists,—a waste which could be easily obviated and turned to a very profitable account."

Mr. Pince said, with regard to the fertilising qualities of the sewage, he wished to state that he had procured a barrel of it, after the application of the carbolic acid. He spread the contents of the barrel over a poor, hungry piece of land, about an inch and a quarter thick. This he did on Thursday night, and after he had spread it he went out and knelt down, and no smell existed. On Friday afternoon he sowed three drills of mustard and three of rape. On Monday morning the seed was up vigorously, showing how actively stimulated it had been by the manure. Now it was broadly in leaf, which was quite black, and he should be happy to show it to any person. If he had had recourse to stable dung he must have spread it ankle-deep in order to have produced such an effect. He believed that those who had previously tried to utilise the sewage had expected too much from it. They had expected that a little would have acted like guano, but this was not so. If, however, it was spread over the land in a fair way, he believed it would have the same beneficial effect as it had had on his land. He did not wish to take the sewage away from the depôt, because it might be said that he was an interested party, but this he could say, that if it was desired he should be happy to have it. Mr. Ellis, in reply to a question, said he had no hesitation in saying that the value of the sewage was considerably improved. The ammonia in escaping caused the smell, and the disinfectant arrested the ammoniacal qualities of the sewage. Mr. Pince said that the man at the depôt, who was scientifically ignorant of the disinfectant, spoke of the altered appearance of the sewage after the disinfectant was applied. He said it was "yeasty-like," and that was so. Mr. Bradbeer said he had noticed the same appearance in the sewage. Mr. Dyer said the ammonia in it was fixed; it was not like guano, the ammonia of which was always evaporating. Mr. Bradbeer said that, as far as the experiment had gone, it had proved successful, but next came the question of expense. Mr. Ellis stated that, including the attendance of the man, the expense per annum would be about 38*l.* 10s. Mr. Pince said that at present the experiment had been conducted in its rudest form; but if it was made self-acting, as it would be, then the expense would be considerably reduced. After some further discussion with respect to utilising the sewage, Mr. Pince said he had received a letter from the Earl of Devon, who said that as soon as he returned from London he should have great pleasure in visiting the depôt, and see it, with a view to the ultimate disposal of the sewage. He (Mr. Pince) was sure that the noble Earl was perfectly earnest about the matter. He would now ask the Board to continue the disinfecting process for a specified time, until some plan was devised for utilising the sewage; and in the meantime he urged the members to unite with him for the purpose of seeing if they could not make a profit of the sewage, and if not to get rid of it without loss or nuisance. The scavenger wanted to cart it away at an expense to the Board, which ought not to be. Mr. Dyer was asked to take the sewage, but that gentleman said he had not time to attend to it. Mr. Pince then repeated his former offer in the same terms, and observed that he thought the reason why Mr. Dyer had failed in his attempt to utilise the sewage was because he had tried to make it into an artificial manure, whereas it should be used in its natural state. Mr. Dyer said he had sent some of his manure to a gentleman at Southmolton, and it having been used for turnips, the gentleman said he had never had a better crop in his life. Mr. Bradbeer said, as the former experiment had been effectual, and as Mr. Pince wished the Board to back him up by continuing the experiments for a certain time longer, so as to see in the meantime what terms they

could make with the landowners, he had great pleasure in proposing that they do continue their present system for a twelvemonth longer. They could also in the mean time appoint a day to meet a committee of the South Devon Directors. It was then resolved, after further discussion, on the motion of Mr. Pince, seconded by Mr. Snow, that the disinfectant operations be continued for another year.

NOTICES OF BOOKS.

The Retrospect of Medicine: being a Half-yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by W. Braithwaite, M.D., &c. &c., and J. Braithwaite, M.B. Vol. XLIII. January to June, 1861. London: Simpkin, Marshall, and Co.

Any Chemist who has felt the want of an Annual Retrospective View of every discovery and practical improvement in Chemical Science—and what English Chemist has not?—will be able to form some idea of the value of a work like this to the medical practitioner. The book is, of course, a compilation from the various medical journals, from which, all relating to the science and practice of medicine and surgery that is worth perpetuating, is brought together, systematically arranged for easy reference, and reduced to a readable compass. It cannot pretend to supersede the weekly periodical, which is, indeed, a necessity for it, as well as for every man who wishes to keep perfectly *au courant* with the progress of science. The object of the Editors is rather to fix in a more stable form the valuable matters which are to be found, necessarily associated with much that is comparatively worthless, in the pages of the weekly publications. This process of precipitation and filtration it is acknowledged the Editors carry on with much skill; and how much the service is appreciated by the profession is shown by the fact that the *Retrospect* has now reached its forty-third half-yearly volume.

The present volume is enriched by a condensation of Dr. Pavy's valuable Lectures on Diabetes, from which we make an extract relating to the testing for sugar in diabetic urine. After reviewing the different tests for grape sugar, Dr. Pavy gives the formula for the preparation of a cupropotassic liquid which he prefers to those of Barreswil and Fehling. The composition of this liquid is as follows:—

"Sulphate of copper . .	320 grains.
Tartrate of potash (neutral)	640 ,,
Potassa fusa . . .	1280 ,,
Distilled water . . .	20 fluid ounces.

Dissolve each in a separate portion of the water, then mix the sulphate of copper and tartrate of potash, and afterwards add the alkali."

The above liquid "is of such a strength that 100 minims of it are exactly decolorized by half a grain of the purest well-dried grape sugar." Dr. Pavy then describes the method he adopts in quantitatively estimating the sugar in diabetic urine,—"100 minims of the blue liquid are taken, and a mixture of one part of urine, with five parts of water (because the urine is too concentrated alone) allowed to fall into it, drop by drop, whilst kept boiling in a small porcelain capsule, over the flame of the spirit lamp or gas. As soon as the blue colour of the copper solution has been completely removed, the operation is at an end. The amount of diluted urine employed, can be read off, and will contain an equivalent to half a grain of glucose." The Doctor reviews at some length, the objections to both the copper and the fermentation tests, neither of which, he shows, can be relied on as giving an infallible indication of the presence of sugar.

The following "*New Salt of Iron and Quinine*," as it is called by Dr. Fergus, may be new to our readers, and is we dare say a very useful compound. It is composed of 80 parts sulphate of magnesia, 15 parts sulphate of iron, and 5 parts sulphate of quinine; or in a scruple 16, 3, and 1 grain of the respective salts. This mixture is quite unalterable in the solid state, and forms a perfectly clear solution, remaining so for an indefinite period. The proportion of quinine may be increased if necessary, an additional quantity being readily soluble in a solution of the salt.

There are many papers of great value and some of rather startling novelty, in this volume, witness that one, utterly destructive to a bilious man's faith in a blue pill, showing that mercury has no specific action on the liver.

We wish we could have to record the publication of a Retrospect of Chemistry as useful to Chemists as this Retrospect of Medicine must be to Medical men.

NOTICES OF PATENTS.

479. *Fire Places.* W. Dray, Farningham, Kent. Dated February 25, 1861.

This invention has for its object the more complete combustion of fuel and the prevention of smoke. The grate or fire-basket is constructed of a cylindrical or spherical form, and is capable of being revolved or turned on pivots, trunnions, or otherwise, so that the gaseous and carbonaceous products evolved immediately after the addition of a fresh supply of fuel may be caused to pass through the hot fire, which by half rotation has been brought above it, and in this manner the consumption of the greater part of the smoke secured.

Such a fire would probably require a little attention to maintain uniformity of heating; its construction, however, is calculated to aid in preventing smoke, and is in principle somewhat similar to the smokeless grate which is fed from below.

505. *Artificial Stone and Cement.* F. Ransome, Ipswich. Dated February 27, 1861. (Not proceeded with.)

This invention is a modification of similar processes for which patents have on previous occasions been granted to Mr. Ransome. For the manufacture of artificial stone the inventor proposes to employ crushed or powdered chalk, which, after being saturated with silicate of soda solution, is moulded into shapes or blocks; then freely exposed to air to allow the material to become dry and hard. The surfaces are then repeatedly washed over with a solution of chloride of calcium to induce the formation by double decomposition of silicate of lime, so that the pores of the mass may be filled with a mineral substance, and, when finally dried, constitute a kind of artificial stone of great durability, and to a certain extent impervious to water. It is proposed to apply the same materials for coating or plastering walls, ceilings, &c.; and by way of enumerating other substances which are equally applicable to these purposes, the inventor claims the use of either of the soluble alkaline silicates in conjunction with quick lime, any one of the soluble salts of the alkaline earths, or the chloride of aluminium or iron.

The processes referred to in the specification have been frequently the subject of experiment and discussion ever since the first announcement of M. Fuchs's original researches. The early objection has not perhaps up to the present time received a satisfactory answer. This relates to a tendency of the chloride of sodium, formed as the secondary product in the double decomposition, to give rise to a kind of efflorescence which impairs, and ultimately destroys, the outer surfaces of the stone by exfoliation.

614. *Improvements in Preventing Incrustation in Steam-Boilers, and in Tanks for Containing the Feed for the same.* J. Farren, Clapham, Surrey. Dated March 13, 1861. (Not proceeded with.)

With the intention of preventing the formation of calcareous incrustation in steam-boilers, the inventor proposes to employ either rain or distilled water for feeding the same. In order then to collect and store a sufficient supply of rain-water for this purpose, it is recommended to construct large tanks for its reception, lined with non-absorbent bricks, united with hydraulic cement, or with water-resisting cement alone.

The applicability of distilled water to these purposes is out of the question, since it involves the consumption of at least a double proportion of fuel to generate but one equivalent of steam. Rain-water could be advantageously employed if it were possible to command a sufficient supply, and by so much as the ordinary well or river water is diluted with rain-water, so will the thickness of the incrustation in the boiler be diminished, but this mode of proceeding resolves itself merely into the common practice of draining the roof into the water-tank from which the engine draws its supply.

Grants of Provisional Protection for Six Months.

1722. William Pask, Lydney, Gloucestershire, "Procuring a colouring matter from the refuse of iron stone, called 'colour spert.'"—Petition recorded July 6, 1861.

1776. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the production or manufacture of fluo-silicates of tin, zinc, and baryta, and their application as pigments for glazing, enamelling, and in the manufacture of glass."—Petition recorded July 15, 1861.

1790. Joseph Pierre Gillard, Paris, "Improvements in the manufacture of soda, carbonate of soda, and hydrochloric acid, and in apparatus connected therewith."—Petition recorded July 16, 1861.

1836. Constantine Nicolaus Kottula, Holborn, London, "Certain new compositions to be used in the manufacture of soap."

1840. William Edward Newton, Chancery Lane, London, "Improvements in engines for obtaining motive power by an explosive mixture of inflammable gases and air."—A communication from Francisque Million, Paris.—Petitions recorded July 22, 1861.

1885. James Robertson, Park Street, Mile End, London, "Improvements in apparatus for the treatment of bodily pain with hot water, steam, hot air, and the like."—Petition recorded July 27, 1861.

1910. Horatio Mearing, Great Randolph Street, Camden Town, London, "An improved lucifer match and prepared paper for igniting the same."—Petition recorded August 1, 1861.

2026. William Wilds, Hertford, "Improvements in apparatus for ventilating."—Petition recorded August 14, 1861.

2023. John Cowdery] Martin, High Street, Barnes, Surrey, "An improvement in treating bones, and the manufacture of the products thereof."—Petition recorded August 15, 1861.

2053. William Bennett, London Street, Paddington, London, "A new and improved composition to be used as fuel, and in the lighting of fires."—Petition recorded August 19, 1861.

2110. Richard Archibald Brooman, Fleet Street, London, "An improved method of treating the hop plant to obtain a material resembling wool."—A communication from Barthélemy Picard, Nancy, France.

2142. Benjamin Browne, King William Street, London, "An improved process for concentrating ores or tailings or separating pulverised mineral substances of different kinds or qualities from each other."—A communication from Henry Eberhard Roeder, Broadway, New York, United States.

2159. Alexander Taille, Agen Lot et Garonne, France, "An improved manufacture of manure."

2161. Henry William Spencer, Stepney Causeway, Commercial Road, London, "Improvements in the manufaature of animal oils, the said improvements relating more particularly to the processes of refining them to be used for lubricating purposes."

2191. George Knight, Foster Lane, London, "Improvements in giving lustre to written and printed letters, figures, and devices."—Petitions recorded September 2, 1861.

2031. John Bethell, King William Street, London, "Improvements in the manufacture from steatite of journals, axle-boxes, and bearings for machinery, axles and spindles; in making smoking pipes, buttons, crucibles, and pots for chemical and smelting purposes, and also of a lubricating compound for railway and other carriages."—Petition recorded August 15, 1861.

2196. Patrick Robertson, Sun Court, Cornhill, London, "Improvements in treating yeast, and in the manufacture of ammoniacal salts and a substitute for animal charcoal."—Petition recorded September 3, 1861.

2213. Frederick Bennett, Upper Works, Bagillt, Flintshire, "An improved method of coating the interior surface of lead and lead composition pipes with tin or its alloys."

2229. Charles Felton Kirkman, Palace New Road, Lambeth, "Improvements in obtaining manure from sewage and in the apparatus employed therein."

2268. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "An improved combination of chemical and mechanical processes for the conversion of fibrous vegetable matters into paper-pulp."—A communication from Louis Achille Carteron, Dieuze, Meurthe, France.—Deposited and recorded September 12, 1861.

Notices to Proceed.

1163. Raoul Bernard, Bordeaux, France, "Improved means of catching flies."

1166. John Rolfe Hunt, Chichester Place, Wandsworth Road, Surrey, "Improvements in the manufacture of gutta-percha, and compounds thereof, with other matters and substances."

1200. Auguste Cesar Achille Gerard de Melcy, Paris, "An improved treatment of natural phosphate of lime for several purposes."—Petitions recorded May 11, 1861.

1207. Francis Puls, Francis Terrace, Hackney Wick, Middlesex, "A mode of preparing an oxidising agent."

1231. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in apparatuses for the manufacture of aërated waters, and in vessels or receptacles for containing the same."—A communication from Jean Louis André and Philippe Ferdinand Guillot, Paris.—Petitions recorded May 14, 1861.

1276. Frederick Oldfield Ward, Hertford Street, May Fair, London, "Improvements in manufacturing manure, and in obtaining accessory products."—Petition recorded May 8, 1861.

1955. Alcidalis Auguste Romain Damoiseau, Paris, "Improvements in apparatus for drawing blood or other fluids from the human or animal body."—Petition recorded August 6, 1861.

1214. Thomas Bell, Usworth House, Gateshead, Durham, "Improvements in the decomposition of the compounds of aluminium and in coating metals with aluminium or its alloys."—A communication from Louis Le Chatelier, Paris.—Petition recorded May 13, 1861.

2221. John Reid, Leith, Mid-Lothian, North Britain, "Improvements in the treatment of gas and the apparatus employed therein with a view to its more accurate measurement in wet gasometers."—Petition recorded September 5, 1861.

CORRESPONDENCE.

On the Theory of Three Primary Colours.

To the Editor of the Chemical News.

Sir,—I am somewhat surprised that all your readers have passed over in silence the paper of Professor J. C. Maxwell, contained in the Chemical News of June 29, on the theory of three primary colours. As I believe he is in error on two or three points, and especially when he affirms that red, green, and blue are the primary colours, perhaps you will kindly allow me to make a few observations on the subject. Mr. Maxwell says that "experiments with pigments do not indicate what colours are to be considered as primary." This he says apparently because "the colours of a mixture of pigments are often very different from a true mixture of the colours of the pure pigments," and because the "green tint produced by mixing most blue and yellow pigments" is unsatisfactory. But the colour resulting from the combination of some of the colours of the solar spectrum is often very different from the intermediate colour of those employed, as well as those resulting from a mixture of coloured bodies; and the reason why some blue and yellow bodies do not produce a pure green is capable of satisfactory explanation. Mr. Maxwell remarks, that "by mixing chrome and ultramarine we get all hues of green." But these bodies are generally not adapted for producing green, because most of the ultramarine has a violet tint, and the chrome an orange one. When we wish to produce a pure colour from a mixture of two others, it is necessary to select either pure colours or, perhaps still better, those which are of the tint of the colour which we desire to obtain. By proceeding in this manner we shall never fail to get pure colours. There are bodies of a crimson colour, and others which are scarlet. The first is a red with a violet hue, and the second is a red with an orange hue. Now, when we wish to obtain a violet colour, we combine a crimson colour with a blue one; but when we wish to produce an orange colour, we mix a scarlet colour with a yellow one. If in the latter case we employ a body of a crimson colour, an orange colour is not produced, but a buff; and if Mr. Maxwell has not been very careful to procure coloured bodies of the proper tint, we need not be surprised that he has failed to obtain satisfactory results, and that he disapproves of the use of pigments and mixtures in determining which are the primary colours.

Evidently coloured bodies form the basis for a sound decision upon this subject; and I cordially agree with the generally received opinion, that red, yellow, and blue are the primary colours, because all colours of bodies can be produced from them, while those colours of bodies cannot be produced from any, and because, as every prismatic colour can be formed by combining the colours of the spectrum, we cannot so readily ascertain by experiments with them which are the primary colours.

Presuming, then, that red, yellow, and blue, are what are known as the primary colours, though it is not meant to include any theory of the manner of their production by the prism. I will attempt very briefly to show that this view is confirmed by experiments with the prismatic rays, in order that it may not be necessary to admit the incongruous statement of Professor Maxwell that red, yellow, and blue, are the primary colours for pigments, while red, green, and blue, are the true primary colours as determined by experiments on the prismatic spectrum. There are three different effects produced when coloured rays of light are superposed:—

1. When all the colours of the spectrum are combined, all colour is destroyed; as it may be also by the superposition of two or three of those colours which would produce the prismatic colours in about the same relative proportion as they are found on the spectrum.

2. When some of the coloured rays are superposed, no colour is destroyed, as in the formation of orange, green, indigo and violet from red, yellow, and blue.

3. When other colours of light are combined, a portion of colour is destroyed and a portion remains, as is always the case when red, yellow, and blue, are produced from the other colours.

This occurs because for colour to be destroyed, the colours combined must be of a certain tint or united in certain proportions, and if one of them be in excess, colour will be produced.

If this is true, it divides the prismatic colours into two classes; and that the division is correctly made, is exceedingly probable, because no one who is theoretically and practically acquainted with colour, can deny that when orange, green, indigo, and violet, are produced by the combination of two of the three colours, red, yellow, and blue, that the sensation of colour produced is a compound of the sensations which the two colours produce separately; and on the contrary, that when red, yellow, and blue, are produced from two of the other four colours, that the sensation produced is not a compound of the sensations which the two colours produce separately. I, therefore, conclude that this natural division of red, yellow, and blue, into one group, and of orange, green, indigo, and violet, into another, and its being the same division as we make of coloured bodies, is a sufficient reason why yellow should still be considered a primary colour.—I am, &c.

J. J.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Quadra-Chloride of Iodine.—Dr. H. Kaemmerer (*Journ. für Prakt. Chem.*, Bd. lxxxiii. s. 21) noticed some small, red, well-formed octohedral crystals, which had separated from some fluid chloride of iodine that had been kept in a sealed tube for about six years. These he at first took for an allotropic modification of the chloride; but analysis showed that they contained four atoms of chlorine to one of iodine, and were consequently an hitherto unrecognised compound of those two bodies. Their formation is explained by the equation $4\ ICl = ICl_4 + 3I$, the iodine remaining dissolved in the mother liquor of the crystals.

Bromine Compounds of Molybdenum.—C. W. Blomstrand describes these (*Journ. für Prakt. Chem.* Bd. lxxxii. s. 433). *Bromide of Molybdenum* ($Mo\ Br_2$), formed by passing bromine vapour over metallic molybdenum strongly heated. Oxybromide is first formed, then a greyish-green sublimate of sesquibromide, and lastly some yellow bromure. A few dark-coloured crystals of the bromide are found mixed with the preceding. The author has varied his experiments, trying various temperatures, and diluting the bromine vapour by varying proportions of carbonic acid, but never could get much of the bromide. It forms brilliant, black, well-formed acicular crystals, which are fusible, and give a brown-red vapour. They deliquesce in the air, and yield a black fluid, give a brownish-yellow solution with water, from which alkalies precipitate a rusty yellow precipitate of oxyhydrate. By heating it is easily decomposed into the sesquibromure and free bromine, $2\ Mo\ Br_2 = Mo_2Br_3 + Br$.

Sesquibromure of Molybdenum.—(Mo_2Br_3) Formed as before, when bromine vapour is passed over metallic molybdenum, and also by the use of a mixture of the oxide and charcoal. It forms, at times, short blackish-green acicular crystals, but is mostly obtained in slender threads, like asbestos. By a strong heat it is decomposed into the bromure and free bromine. Under ordinary circumstances the sesquibromure has great stability. The threads made into a ball and thrown on water swim like a cork. It is not sensibly attacked by boiling hydrochloric

acid, nor by dilute nitric acid at the ordinary temperature. Dilute alkalies act on it slowly in the cold, and on boiling perfectly decompose it.

Bromure of Molybdenum.—(Mo Br, or Mo_3Br_2, Br) Formed when the sesquibromure is heated to redness, and by the direct action of bromine in the metal. It is altogether insoluble in water and acids, but dissolves in boiling dilute alkalies, the yellow solution thus formed containing the bromomolybdous oxide united with an alkali, Mo_3Br_2, Br + 2 KO HO = KBr + KO, Mo_2Br_3, O. The yellow solution, on standing, yields small, brilliant, orange-coloured crystals, of the compound Mo_3Br_2O + 9HO. Saturated with carbonic or acetic acid, the hydrate, Mo_2Br_2, O + 3HO, is precipitated. The author notices another salt, the bioxybromide of molybdenum, formed in the same way as the corresponding chlorine compound lately described. It is obtained in orange-coloured scales of peculiar brilliancy, deliquesces in the air, and gives a colourless solution with water.

Composition of a Roman Mirror.—Souchay had the opportunity of analysing a fragment of a Roman mirror dug up near Mayence. It was of a greyish-white colour, brittle under the hammer, had a fine granular fracture, the fractured surfaces showing small holes filled with small metallic prisms. The sp. gr. = 9·21. The per-centage composition was,—tin, 19·05; lead, 17·29; copper, 63·39. The alloy was probably made by melting together 1 part of tin, 1 of lead, and 3 of copper.—*Journ. für prakt. Chem.*, Bd. lxxxii., s. 275.

Combustible Gas in a Salt Mine.—There is an opening in the deepest part of the Wieliczka mine, from which a stream of gas issues. When a light is brought in contact, the gas ignites, and a flame two or three feet long is seen. It quickly lessens, however, and soon goes out. Pebal (*Annal. der Chem. und Pharm.*, Bd. cxviii., s. 27) analysed the gas, and found it to be composed of

Nitrogen	65·47
Carbonic acid	1·18
Oxygen	12·90
Light carburetted hydrogen.	20·45
	100·00

MISCELLANEOUS.

Telegraphic Night Signals.—On the evenings of the 24th and 25th ult. a series of experiments were made under the direction of Captain Bolton, for the purpose of ascertaining the capabilities of the lime-light as a means of communicating by signals between distant stations during the night. Southend and Sheerness were the stations selected, and, as the result of the trial, it was found practicable to hold correspondence by a system of time signals depending upon the alternate exhibition and screening off of the light. Notwithstanding the haziness over the water at the time, it was not difficult to interpret the indications on the opposite shores—the stations being distant from each other six miles. Further experiments are in contemplation to be carried out at Portsmouth over sea and land, when the *Excellent* gunnery ship will be provided with one of the signal lamps.

The Prevention of Railway Accidents.—With that keen attention to passing events which characterised his former management of the Polytechnic, Mr. Pepper has recently provided the visitors to that ever-attractive institution with a new lecture on the prevention of railway accidents, a subject which the recent catastrophes at Kentish Town and in the Clayton tunnel have invested with a fearful interest. The lecture was illustrated by numerous models and diagrams, among which may be mentioned those of Mr. Delafond's apparatus for the prevention of accidents through attempts to enter or leave trains in motion, and Mr. Allen's electric bell and dial, for instantaneous communication between guard and driver. The great feature of the lecture, however, as bearing directly upon recent disasters, was a series of beautiful models of the safety kerb and life guards, patented by Mr. Wright, C.E. The former consists of a strong iron kerb, backed with earth, and of sufficient height to prevent locomotives or carriages from running off the rails, parallel to which the kerb is firmly fixed. In the case of the wheels mounting the rail, they rub against the kerb, and are turned on to the rail again directly, without the possibility of an accident. The life guards are strong pieces of iron, so affixed that, should a wheel or axle break, they rest on the kerb, supporting the carriage, and, by their grating, warning the guard, while they act also as a drag. Some beautiful photographs of the new International Exhibition building, produced by Messrs. Birnstingle, were shown, after the lecture, by Parr's new electric lamp.

Grocers *v.* Doctors.—A Company is, we understand, in progress of formation, to be called "The Equitable Grocery Consumers' Company;" and its object is—at least, so says the programme, 'to supply the public with all descriptions of grocery in a pure and unadulterated state.' Every pater- and materfamilias will feel deeply obliged to such an enterprising grocery establishment, provided only it will carry out punctually its promises. The benefits of it would reach very widely; for it would teach all other grocers to mend their wares. We have often adverted to the rascality of trade now pretty universally going on; and have also shown that the certificates of purity of their wares, as usually given by chemists and microscopists to the shopkeepers, are mere delusions, and worse than delusions. These certificates are, in fact, mere traps to catch customers; and we must say that those gentlemen who are such free dispensers of them are rather to be considered as abetting the tricks of the rascally shopkeeper than defending the public. Analyses of the kind we refer to are, in truth, scientific warrants, which may be, and often are, used as a cover or shield, under which vile goods are sold as superfine. Molasses of Oxford-street takes a specimen of his goods—we need not say Number One of its kind—to Dr. Singleeye, who, after due microscopical and chemical investigation of its nature, supplies Molasses with a certificate testifying that his specimen is perfect of its kind. Molasses bows and smiles, and thankfully pays his *honorarium*. He then repairs to his printer, and has a few thousand of the certificates struck off, and pasted on to the most villanous of wares. These wares then go forth to the world under the trumpet and patronage of the famous Professor Singleye. We will say that on the very face of it, and in the way here described, our men of science in the analytic line are assisting rascally tradesmen in the distribution of their rascalities. May this Company teach and follow a better path.—*Brit. Med. Journal.*

ANSWERS TO CORRESPONDENTS.

F. W. G.—The complete researches are not yet published. We will give an account of the experiments as soon as possible.

J. J.—The paper was received with thanks.

A Reader.—The methods of calculating formulæ of chemica compounds from the per-centage composition are given in a very complete manner in the last edition of Frosenius' Quantitative Analysis, published by Churchill, pp. 452 to 476.

C. R. C. Tichborne.—Received with thanks. A proof will be sent.

Alfred Peile.—We do not know the price. The book is published by Baillière, Regent Street.

Book Received.—"An Introduction to Practical Chemistry." By John E. Bowman. Edited by C. L. Bloxam. Fourth Edition. London: Churchill.

THE CHEMICAL NEWS.

VOL. IV. No. 97.—October 12, 1861.

THE PRESERVATION OF BUILDING STONE.

(*Continued from page* 181.)

July 17, 1861.

Sir,—Having been requested to submit to the Committee our opinion on the nature and causes of the decay of building stones generally, and of the stone employed in the construction of the New Houses of Parliament in particular, we now have the honour to submit the following observations:—

Building stones in general may be divided into two classes:—

1. Those which consist of materials not easily acted upon by acids.

2. Those composed of materials which are, partially or entirely, acted upon by acids with facility.

As an illustration of the first class, granite porpheries and serpentines may be quoted, whilst to the second belong limestones, dolomites, and certain sandstones, containing carbonate of lime as cementing material.

The stone used in the New Houses of Parliament belongs to the second class of building materials, consisting, as it does, almost entirely of the carbonates of lime and magnesia. The following analyses of several varieties of dolomite by Professor Daniell and Messrs. T. Ransome and B. Cooper, are quoted in illustration of the general composition of the stone in question[1]:—

	Bolsover Moor.		North Anston.		Woodhouse.	Steetley.
	Daniell.	Ransome and Cooper.	Ransome and Cooper.	Ransome and Cooper.	Ransome and Cooper.	Ransome and Cooper.
				Stone Ends.		
Carbonate of lime	51·1	52·07	54·89	55·37	52·80	53·95
Carbonate of magnesia	40·2	40·60	42·07	41·71	44·31	43·78
Sulphate of lime	..	..	..	..	..	trace
Protoxide of iron	..	0·89	0·49	0·73	0·63	0·64
Oxide of iron and alumina	1·8	..	..	..	..	..
Peroxide of iron	..	0·83	0·24	..	..	..
					Carbonate.	
Protoxide of manganese	..	trace	trace	1·68	1·84	..
Silica	3·6	3·64	0·56	0·92	0·47	0·44
Water	3·3	0·48	0·51	0·45	0 23	0·12

	Roach Abbey.	Huddlestone.	Park Moor.	Lindley's Bolsover Quarry, Woodhouse, near Mansfield
	Daniell.	Daniell.	Daniell.	Ransome and Cooper.
Carbonate of lime	57·5	54·19	55·7	54·05
Carbonate of magnesia	39·4	41·37	41·6	38·58
Protoxide of iron	..	..	..	0·74
Peroxide of iron	..	..	..	0·62
Oxide of iron and alumina	0·7	0·30	0·4	..
Carbonate of manganese	..	..	..	2·43
Silica	0·8	2·53	0·0	1·30
Water	1·6	1·61	2·3	0·46

[1] The analyses by Daniell are quoted from the "Report of the Inquiry undertaken under the Authority of the Lords Commissioners of Her Majesty's Treasury, by C. Barry, Esq., H. T. De La Beche, Esq., W. Smith, Esq., and Mr. Charles Smith, with reference to the Selection of Stones for Building the New Houses of Parliament." Those by Ransome and Cooper are extracted from a paper "On the Composition of Limestones used for Building Purposes, especially on those employed in the Erection of the New Houses of Parliament," contained in vol. ii., part ii. (1848) of the "Memoirs of the Museum of Practical Geology."

Regarded from a purely chemical point of view, the difference in the resisting power to corrosive agents of different stones would appear, at first sight, to depend entirely upon their chemical composition; but even a moderate acquaintance with the properties of the components of such building stones demonstrates that there are other conditions at least equally instrumental in determining the degree of permanence of different stones.

It is a well-established fact, that the same chemical substance exhibits, in different conditions, a great variation in its behaviour with chemical agents. Numerous examples might be quoted in illustration of this. Thus, marble and chalk are chemically identical, but, owing to the difference in their physical structure, the one being crystalline and the other amorphous, the former is much less readily acted upon by acids than the latter. Again, artificial peroxide of iron is readily soluble in acids; peroxide of iron, in the form of hæmatite, is attacked with difficulty by acids; and the same oxide, after exposure to a powerful heat, is almost entirely insoluble in acids. The influence of aggregation in these instances, and in numerous others which might be quoted, is obvious and generally admitted by chemists, however different and imperfect may be their views regarding the connection between physical condition and chemical effect.

The observations just made regarding the behaviour of substances, such as enter into the composition of building stones, cannot but apply with equal force to the aggregates of such components,—to the building stones themselves.

The atmospheric influences to which building stones are subject are many of them essentially chemical actions, involving processes analogous to, or identical with, those performed in the laboratory, although, from the extreme dilution of the chemical agents, as existing in the atmosphere, they must necessarily be of a very gradual character.

There are few instances in which the influence of the state of aggregation upon the permanence of a building stone is more apparent than in that of the dolomitic limestone, used in the construction of the New Houses of Parliament. Here, in one and the same block of stone, of comparatively small dimensions, we find certain portions of the surface powerfully disintegrated, while others appear in a perfectly sound condition. Chemical analysis has hitherto failed to establish any important difference in the composition of sound portions of such stones and those parts which are subject to decay; it is, therefore, legitimate to attribute the unequal permanence of the stone, under atmospheric influences, to such

structural differences as may be comprehended under the term, "state of aggregation."

Before proceeding to an examination of the particular character of the decay observed in the stones of the New Houses of Parliament, it may perhaps be desirable to glance at the nature of the changes to which building stones generally are subject under atmospheric influences. Under normal conditions these changes must be ascribed to the action of the oxygen, carbonic acid, nitric acid, and water in the atmosphere. In the air of towns, however, there are certain other constituents, such as several acids of sulphur, and occasionally hydrochloric acid, which cannot fail to exert an additional disintegrating influence upon building stones.

The action of oxygen must be of comparatively a subordinate character, its effects being confined to constituents which occur but rarely, and generally in limited proportions, in building stones, such as the sulphides of iron, and the protoxides of iron and manganese; these compounds, being very prone to oxidation, would tend to disintegrate the stones by the absorption of oxygen. Of far greater importance are the effects of carbonic acid and water. Carbonic acid, in the presence of water, is a powerful solvent; it not only corrodes the calcareous and magnesian carbonates (more or less powerfully according to their state of aggregation), whether they form the principal constituents of the stone or are only present as cementing materials, but is capable even of attacking and gradually decomposing the hardest and most indestructible rocks.

In the case of the calcareous and magnesian constituents of stones, carbonic acid acts by transforming the insoluble earthy carbonates into soluble bicarbonates, which are thus removed from the substance of the stone; whilst its influence on silicious rocks consists in the elimination of the alkaline bases, in the form of carbonates, and the separation of the silica in a more or less friable condition. The weathering of granites, and their gradual transformation into the several varieties of porcelain clay, affords an interesting illustration of the latter kind of action. In the changes just mentioned, the carbonic acid and water are equally concerned; the water serving not only as a vehicle for the introduction of the carbonic acid into the pores of the stone, but also as a solvent for the products of its action. There are changes, however, to which building stones are subject, in which water is the sole agent, and which are more of a mechanical than of a chemical character. The expansion which water undergoes on freezing, and the irresistible force which it then exerts, are well known; it is obvious that water freezing within the pores of a stone must exercise a disintegrating action not less powerful than those above referred to.

Recent researches have demonstrated that nitric acid is a frequent and perhaps even a normal constituent of the atmosphere, and, as such, must undoubtedly assist in the destruction of magnesian and calcareous stone; but the proportions in which this acid has been found are so minute that it need not be dwelt upon as an important destructive agent. This remark, however, does not apply to the acids referred to above, as existing in the atmosphere of towns. The quantity of sulphur-acids in the air of towns, where a considerable amount of coal is consumed, is quite appreciable. According to the determinations of Dr. Angus Smith, the air of Manchester contains an average proportion, corresponding to one part of sulphuric acid in every 100,000 parts of air, which, in the centre of the town, rises to 25 parts in 100,000. No numerical data exist with regard to the proportion of sulphur-acids in the London atmosphere, but it can scarcely be doubted that in the neighbourhood of the New Houses of Parliament they are present to an extent equal to the average amount found in the Manchester air; they must, therefore, be regarded as amongst the more important agents destructive to stone which are present in the London atmosphere.

A few observations remain to be offered regarding the particular nature of the decay manifesting itself in some of the stones of the New Houses of Parliament. It has already been pointed out that, so far as our experience goes, we are inclined to attribute the local character of the decay to structural differences obtaining in different parts of the stone. The general structure and the composition of the stone in the New Houses of Parliament render it moreover amenable to all the sources of disintegration which we have above enumerated, with the exception perhaps of oxygen, which can scarcely produce any appreciable alteration in dolomite. Thus, the chemical action of carbonic and sulphuric acids, in combination with water, will gradually dissolve and remove the carbonates of lime and magnesia, whilst the porous nature of the stone renders it liable to the mechanical effects of water under the influence of frost. The presence of sulphuric acid in the air of towns appears, in the case of magnesian limestone, to bring into play another process of destruction. This acid not only corrodes and renders soluble, as we have pointed out, the earthy carbonates (in which respect it resembles carbonic acid in its effects), but, forming with magnesia a readily crystallisable salt, the well-known sulphate of magnesia, remarkable for the large proportion of water of crystallisation which it fixes, it gives rise, in addition, to a mechanical destruction of the stone precisely similar to that produced by freezing water. The powerful mechanical effects resulting from the solidification of water, induced by crystallisation, are well known, although it would appear that they have not hitherto been sufficiently appreciated as auxiliaries in the process of disintegration of stone. The analogy between the solidification of water, by freezing and by crystallisation, is perfectly obvious, and a French chemist has suggested, as a means of recognising stones liable to disintegration by frost, to immerse them in a solution of sulphate of soda, and to note the subsequent effects of its crystallisation within the stone.

We have ourselves recently had occasion to observe some phenomena which go far to elucidate these destructive effects of crystallisation. The exfoliations exhibited by many of the fictile vases deposited in the British Museum were found to be due to the formation and crystallisation within the substance of the vessels of nitrate of lime. Again, in experiments on the preservation of fabrics by impregnation with saline substances, it was found that the crystallisation of sulphate of magnesia within the material produced a disintegrating effect upon the fibres, sufficient greatly to weaken the material.

In conclusion, we would remark, that the effect attributed to the crystallisation of the sulphate of magnesia, in assisting the decay of dolomitic stones, and more particularly of those used in the construction of the New Houses of Parliament, is borne out by the existence of a marked efflorescence of sulphate of magnesia upon those portions of the stone where exfoliation has taken place.

We have, &c.

(Signed) A. W. Hofmann.
E. Frankland.
F. A. Abel.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Classification of Organic Substances by Series, by James Schiel, *of St. Louis.*

The progressive series which, in 1842,[1] I introduced into organic chemistry, have become the chief means of classification, and of connecting organic substances generally. Several years after the introduction of the series, Gerhardt used them in the sense just mentioned in his "Traité de Chimie," and thereby contributed a great deal toward their general knowledge.[2] But the idea this distinguished chemist had formed of series was very imperfect, as is proved by the single fact that he ranged benzoic acid and acetic acid in what he called an isologous series ("Traité," t. i., p. 127). As in the present state of chemical science it is highly important that the principles of seriation be clearly understood, I will try to expound them in a more general and methodical manner than has been done hitherto.

The general formula of organic compounds containing carbon, hydrogen, and oxygen, is $\mathrm{C}\alpha\mathrm{H}\beta\mathrm{O}\gamma$. By giving to γ successively the values 1, 2, 3, 4, . . . we may form the following series of oxidation :—

$$\begin{array}{ll} (\mathrm{A}) & \mathrm{C}\alpha\mathrm{H}\beta\mathrm{O} \\ & \mathrm{C}\alpha\mathrm{H}\beta\mathrm{O}_2 \\ & \mathrm{C}\alpha\mathrm{H}\beta\mathrm{O}_3 \\ & \mathrm{C}\alpha\mathrm{H}\beta\mathrm{O}_4 \\ & \vdots \end{array}$$

From this all the series necessary for the classification of organic substances may be derived by putting $\alpha=n$ and $\beta=2n+2$, making β successively to decrease, the decrement being 2, 4, 6, 8, . . . By this we have the following series :—

I.	II.	III.	IV.
$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}$	$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}$	$\mathrm{C}_n\mathrm{H}_{2n-2}\mathrm{O}$	$\mathrm{C}_n\mathrm{H}_{2n-4}\mathrm{O}$
$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_2$	$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}_2$	$\mathrm{C}_n\mathrm{H}_{2n-2}\mathrm{O}_2$	$\mathrm{C}_n\mathrm{H}_{2n-4}\mathrm{O}_2$
$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_3$	$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}_3$	$\mathrm{C}_n\mathrm{H}_{2n-2}\mathrm{O}_3$	$\mathrm{C}_n\mathrm{H}_{2n-4}\mathrm{O}_3$
⋮	⋮	⋮	⋮

and so forth.

Every general formula in one of these generic series represents special homologous series, the members of which have the difference $n\mathrm{CH}_2$. When comparing the above series with the hydrocarburets known to exist in a free state, they will be found to represent different states of oxidation of these hydrocarburets.

Another kind of series is formed by making in the general formula $\alpha=n$ and $\beta=n$ and making β successively to decrease or increase, the increment or decrement being, 1, 2, 3, 4, ... By this we form the series:

$$\begin{array}{ll} (\mathrm{B}) & \mathrm{C}_n\mathrm{H}_n\mathrm{O}\gamma \\ & \mathrm{C}_n\mathrm{H}_{n\pm1}\mathrm{O}\gamma \\ & \mathrm{C}_n\mathrm{H}_{n\pm2}\mathrm{O}\gamma \\ & \mathrm{C}_n\mathrm{H}_{n\pm3}\mathrm{O}\gamma \\ & \vdots \end{array}$$

Every general formula here represents a series, the members of which are distinguished by $m\mathrm{CH}$, and which I therefore call hemilogous series. It is to be remarked that a hemilogous series whose general formula is

$$\mathrm{C}_n\mathrm{H}_{n\pm1}\mathrm{O}\gamma,$$

can only exist when n is an odd number, as the number of atoms of hydrogen entering into an organic compound is always an even number.[3] The hemilogous series are very useful for comparing the physical properties of organic substances.

I will now apply these principles of classification to three large classes or groups of substances, the hydrocarburets, the alcohols, and the acids. The generic series formed by the first of these groups is the following :—

$\mathrm{C}_n\mathrm{H}_{2n+2}$ hydrurets of the radicals of the alcohols ;
$\mathrm{C}_n\mathrm{H}_{2n}$ the homologues of ethylen and the radicals of the alcohols ;
$\mathrm{C}_n\mathrm{H}_{2n-2}$ acetylen $n=2$; allyl $n=6$;
$\mathrm{C}_n\mathrm{H}_{2n-4}$ thymen $n=10$;
$\mathrm{C}_n\mathrm{H}_{2n-6}$ benzol $n=6$, toluol $n=7$, xylol $n=8$, cumol $n=9$, cymol $n=10$.
⋮
$\mathrm{C}_n\mathrm{H}_{2n-14}$ stilben $n=14$;
$\mathrm{C}_n\mathrm{H}_{2n-20}$ hydrocarburet found in the tar of Archangel, $n=19$.

The maximum or minimum number of atoms of hydrogen which may be combined with n atoms of carbon cannot be determined at present, but there is no hydrocarburet known to contain more than $(2n+2)$ and less than $2n-(n+2)=n-2$ atoms of hydrogen to n atoms of carbon.

The alcohols form several generic series :—

Alcoholic series I.

$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}$ common alcohols of the type $\left.\begin{matrix}\mathrm{C}_n' & \mathrm{H}_{2n+1} \\ & \mathrm{H}\end{matrix}\right\}\mathrm{O}$
$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_2$ glycolic alcohols of the type $\left.\begin{matrix}\mathrm{C}_n'' & \mathrm{H}_{2n} \\ & \mathrm{H}_2\end{matrix}\right\}\mathrm{O}_2$
$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_3$ glycerine ,, $\left.\begin{matrix}\mathrm{C}_n''' & \mathrm{H}_{2n-1} \\ & \mathrm{H}_3\end{matrix}\right\}\mathrm{O}_3$
⋮

Whether tetracid alcohols of the general formula

$$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_4 \text{ and the type } \left.\begin{matrix}\mathrm{C}_n & \mathrm{H}_{2n-2} \\ & \mathrm{H}_4\end{matrix}\right\}\mathrm{O}_4$$

can exist, is not known, as we know nothing certain about the existence of tetrabasic radicals. The polyethylenic glycols of the general formulas

$$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_4$$
$$\mathrm{C}_n\mathrm{H}_{2n+2}\mathrm{O}_5$$

are bibasic alcohols corresponding to the type

$$\left.\begin{matrix}(\mathrm{C}_n\mathrm{H}_{2n})_{m-1} \\ \mathrm{H}_2\end{matrix}\right\}\mathrm{O}_m.$$

Alcoholic series II.

$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}$ allylic alcohols of the type $\left.\begin{matrix}\mathrm{C}_n' & \mathrm{H}_{2n-1} \\ & \mathrm{H}\end{matrix}\right\}\mathrm{O}$
$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}_2$,, glycols ,, $\left.\begin{matrix}\mathrm{C}_n'' & \mathrm{H}_{2n-2} \\ & \mathrm{H}_2\end{matrix}\right\}\mathrm{O}_2$
$\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}_3$,, glycerine ,, $\left.\begin{matrix}\mathrm{C}_n''' & \mathrm{H}_{2n-3} \\ & \mathrm{H}_3\end{matrix}\right\}\mathrm{O}_3$
⋮

Of this series the only member known as yet is allylic alcohol $\mathrm{C}_3\mathrm{H}_6\mathrm{O}$ corresponding to the general formula $\mathrm{C}_n\mathrm{H}_{2n}\mathrm{O}$.

Alcoholic series III. IV. V.

$\mathrm{C}_n\mathrm{H}_{2n-2}\mathrm{O}$, $\mathrm{C}_n\mathrm{H}_{2n-2}\mathrm{O}_2$, etc.
$\mathrm{C}_n\mathrm{H}_{2n-4}\mathrm{O}$, $\mathrm{C}_n\mathrm{H}_{2n-4}\mathrm{O}_2$, etc.
$\mathrm{C}_n\mathrm{H}_{2n-6}\mathrm{O}$, the homologues of phenylic alcohol ;
$\mathrm{C}_n\mathrm{H}_{2n-8}\mathrm{O}$, ,, cinnamylic alcohol.

[1] *Annal. Liebig and Wöhler*, July number, 1842.

[2] Gerhardt changed the name progressive into homologous ; in the discovery itself of the series he has no share.

[3] If one atom of nitrogen enters into the compound, the atoms of hydrogen are an odd number, as nitrogen is triatomic. For this reason alone the formula of quinine, for instance, could not be written $\mathrm{C}_{10}\mathrm{H}_{12}\mathrm{NO}$, as chemists formerly used to do, but $\mathrm{C}_{20}\mathrm{H}_{24}\mathrm{N}_2\mathrm{O}_2$ as it is written now for other reasons.

The homologous series answering the general formula $C_nH_{2n-6}O$ is

C_6H_6O	phenylic alcohol	boiling point,	184°
C_7H_8O	benzoylic	,, ,,	204°
$C_8H_{10}O$	xylenic	,, ,,	220°
$C_9H_{12}O$	(?)		
$C_{10}H_{14}O$	cuminic	,, ,,	243°

as homologous with phenylic alcohol, the last member of this series, cuminic alcohol, ought to boil at 264°.

Forming a hemilogous series out of such of those alcohols as answer to the general formula $C_nH_{n+1}O$, we have:—

C_7H_8O	benzoylic alcohol	boiling point 204°
$C_9H_{10}O$	cinnamylic ,,	,, 250°

The difference in composition is here $2CH$, the difference in boiling point 46°; to the difference CH in composition there corresponds therefore a difference in the boiling points of 23°, and as to the difference CH_2 we mostly find a difference of 19°—20° in boiling points, the influence of the atom of H on the boiling point is in this case 3°. In a similar manner the influence of C on the boiling point may be shown to be 26°, as benzoylic alcohol and cinnamylic alcohol differ by $C+CH_2$ and CH_2 answers to 20°, we have 46°—20°=26°. The influence of the single elements on the boiling point may thus be found by seriation and general laws deduced by comparing the different results obtained by this method.

(To be continued.)

On the Estimation of Tin by Standard Solutions, by M. Scheurer-Kestner, *of Thann.*

(Continued from page 102.)

For estimating the oxide of tin by permanganate of potash (or, what comes to the same thing, a solution of protochloride with the addition of carbonate of soda), I made use of the ingenious method M. Péan de Saint-Gilles[1] employed while studying the oxidising action of permanganate in alkaline liquids. This method consists, as is well known, in the joint use of permanganate of potash and protochloride of iron.

In making the following experiments a slight excess of carbonate of soda was added to the protochloride of tin, then an excess of permanganate of potash; and, lastly, ferrous chloride and acid.

Thus, the following are the standard solutions:—

Sn Cl. employed. Cubic centimètres.	Quantities of water.	Observed With the protoxide.	Standard. With the protochloride.
2	400	14	14
2	500	14	14
2	600	14	12
2	700	14	10
2	1000	14	8
2	1500	14	5·5
2	2000	14	5
2	3000	14	4·2
2	3000	14	4

The small degree of affinity between oxide of tin and oxygen is made evident by passing a current of oxygen in a solution of protochloride of tin with carbonate of soda in excess. A solution containing 2 cubic centimètres of protochloride to 1000 cubic centimètres of water is unaltered, even though a rapid current of oxygen is passed through it for two hours.

The oxygen of water then has no influence on protoxide of tin, and the results obtained are very regular, which explains why M. Lenssen, by using an alkaline liquid, arrived at corresponding results.

This property might be of service in estimating the oxygen dissolved in water if the oxidation of the protochloride were not so slow. It is sometimes necessary to wait very long before adding the permanganate, until all the oxygen of the water is absorbed, which is always done after some time, as may be seen by the following experiments:—

Water.	Permanganate required by the Chloride of Iron.	Permanganate required by the Protoxide of Iron.	Permanganate required by the Protochloride of Tin.
1500	24	12·5	After quarter of an hour 15 After half an hour . . 13

We have seen that M. Stromeyer, by a happy modification, has reduced the estimation of tin to that of iron. Applying the same principle, a salt of copper may be substituted for a salt of iron. An equivalent quantity of copper can thus be estimated in place of tin; and M. Mohr's as well as M. Terreil's[2] experiments show that copper can be very exactly estimated by permanganate of potash.[3]

A double decomposition takes place on protochloride of tin being added to nitrate or chloride of copper in excess; a salt of suboxide of copper forms, and the tin passes to the maximum state of oxidation, according to the following equation:—

$$4CuO + 2SnCl = 2Cu_2O + SnCl_2 + Sn_2O.$$

To estimate tin, it is, then, sufficient to transform it into protochloride, to add to it a solution of nitrate of copper, slightly in excess, before diluting it with water, and to estimate the liquid obtained by permanganato of potash.

The following experiments show that, whether the operation is performed with nitrate of copper or whether we avail ourselves of oxidation in an alkaline medium, the results are the same:—

10 c. c. SnCl in 1200 c. c. of water required	52	of permanganate
10 ,, SnCl in 1200 c. c. of water, to which is added $CuO.NO_5$, required	87	,,
10 ,, $SnCl + NaOCO_2 + SO_3 + FeCl$ required	231	,,
Deducting that needed for the salt of iron	144	,,
Leaves remainder . . .	87	the salt of tin.

1·117 gr. of tin, obtained by the electrical means, were dissolved in hydrochloric acid and diluted with water sufficient to make the entire volume 200 cubic centimètres. 30 cubic centimètres of this solution required 9·2 cubic centimètres of permanganate, whether the operation is performed with nitrate of copper or with an alkaline solution.

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[1] *Annales de Chimie et de Physique*, vol. lv., third series.

[2] *Comptes-Rendus*, vol. xlvi., p. 230.

[3] For the estimation of copper, variable quantities of water can be used without affecting the results:—

Water employed.	Permanganate required by a reduced salt of copper.		
0	16·3		
100	16·4	16·3	16·4
500	16·3		
1000	16·3		
1500	16·4	16·3	16·3
2000	16·3		
2500	16·4	16·3	
3000	16·4		

Permanganate was standardised by means of crystallised double sulphate of iron and ammonia $FeO, SO_3 + NH_4OSO_3 + HO$.

2·918 gr. of this salt required 24 cubic centimètres of permanganate. The salt containing 14·386 per cent. of iron, the 2·918 grm. of it contain 0·416865, or, rather, 1 cubic centimètre of permanganate = 0·017268 of iron, corresponding to 0·01818 of tin ($59Sn = 2 \times 28 = 56$ Fe.)

9·2 cubic centimètres of permanganate were required by 30 cubic centimètres of the foregoing solution of tin, making 0·16725 of tin.

Thus, we have :—

Tin taken . . .	0·16755
Tin found . . .	0·16725
Difference =	0·00030

By calculating the equivalent of tin by these data, and by removing the iron from it, we obtain 59·105, which differs little from 59·00, the number generally adopted.

The result of these experiments is, that by passing an oxgyen current through a concentrated solution of protochloride of tin, the oxygen is not fixed; in diluted solutions, on the contrary, the oxygen is rapidly absorbed by the stannous salt. Oxygen does not act on hydrated protoxide of tin. The variations noted in the strength found when protochloride of tin is oxidised by permanganate of potash are not observed in concentrated solutions; they take place only in presence of oxygen dissolved in water.

There are three different processes for estimating tin by permanganate of potash :—1. To operate with water freed from air by boiling, protecting it from access of air while cooling. 2. To oxidise protoxide of tin in an alkaline medium. 3. To decompose protochloride of tin either by a salt of iron, as proposed by M. Stromeyer, or by a salt of copper.

On Ozone, Nitrous Acid and Nitrogen, by T. Sterry Hunt, *F.R.S.*

The formation of a nitrite when moist air is ozonized by means of the electric spark (the old experiment of Cavendish), or by phosphorus was shown by Rivier and de Fellenberg, who concluded that the reactions ascribed by Schönbein to ozone were due to traces of nitrous acid. The subsequent experiments of Marignac and Andrews have, however, established that ozone is really a modification of oxygen, which Houzeau has shown to be identical with the so-called nascent oxygen, which is evolved, together with ordinary oxygen, when peroxyd of barium is decomposed by sulphuric acid at ordinary temperatures. The spontaneous decomposition of a solution of permanganic acid also evolves a similar product having the characters of ozone.

Believing that the nitrous acid in the above experiments is not an accidental product of electric or catalytic action, but dependent upon the formation of active or nascent oxygen, I caused a current of air to pass through a solution of permanganate of potash mixed with sulphuric acid. The air, which had thus acquired the odour and other reactions of ozone, was then passed through a solution of potash; by which process it lost its peculiar properties, while the potash solution was found to contain a salt having the reactions of a nitrite.

As I suggested in this Journal in 1848, I conceive gaseous nitrogen to be the anhydrid amid or nitryl of nitrous acid; which in contact with water might under certain circumstances generate nitrous acid and ammonia. From the instability of the compound of these two bodies, however, it becomes necessary to decompose one at the instant of its formation in order to isolate the other. Certain reducing agents which convert nitrous acid into ammonia may thus transform nitrogen (NN) into $2NH_3$. In this way I explain the action of nascent hydrogen in forming ammonia with atmospheric nitrogen in presence of oxydising metals and alkalies. (Zinc in presence of a heated solution of potash readily reduces nitrates and nitrites with the evolution of ammonia.)

Now, an agent which instead of attacking the nitrous acid would destroy the newly-formed ammonia, would permit us to isolate the nitrous acid. Houzeau has shown that nascent oxygen is such an agent, at once oxydising ammonia with formation of nitrate (nitrite ?) of ammonia, and thus when ozone (nascent oxygen) is brought in contact with moist air both of the atoms of nitrogen in the nitryl (NN) appear in the oxydised state.

From this view it follows that the odour and most of the reactions ascribed to ozone are due to nitrous acid which is liberated by the decomposition of atmospheric nitrogen in presence of water and nascent oxygen. We have thus a key to a new theory of nitrification and an explanation of the experiments of Cloez on the slow formation of nitrite by the action of air exempt from ammonia upon porous bodies moistened with alkaline solutions. I hope soon to send the results of my farther inquiries in this matter.—*American Journal of Science*, Vol. xxxii., No. 94.

On the Formation of Picramic Acid, by M. Carey Lea.

It is to M. Aimé Girard that we owe the first isolation of picramic acid, and correct determination of its constitution. His views, however, of the circumstances under which it is formed do not altogether agree with the results of my observations, and I advert to them now, because his second paper contains a criticism on the results obtained by another chemist, which criticism I think depends upon an inexact view of the reactions.

In a paper published by Dr. Evan Pugh, in Liebig's "Annalen," he endeavoured to establish the identity of picramic acid with Wöhler's nitrohæmatic acid. M. Girard, while he agrees with Mr. Pugh in his conclusions, rejects his experiments and reasonings as insufficient.

"This chemist, in fact," he says, "proceeded exactly as Mr. Wöhler had done before I demonstrated the formation of picramic acid by means of sulphydric acid. His process consists in mixing picric acid with protosulphate of iron, boiling with excess of baryta, precipitating the soluble baryta salt with ammoniacal acetate of lead, and finally in decomposing the lead salt by sulphydric acid. Now it is evident that under these circumstances, even supposing that the protoxide of iron had not converted the picric acid to picramic, the sulphydric acid alone would have produced this reduction."[1]

At first sight this conclusion seems perfectly legitimate, so much so, that it is probable that no test by experiment was thought necessary. Had such been made it would have been ascertained that sulphydric acid is wholly without power to reduce picric acid whether free or in combination with lead, to picramic acid.

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[1] *Comptes Rendus*, xlii. 59.

The fact appears to have been overlooked that sulphydric acid is quite incapable of producing this reaction either upon picric acid, or, as far as my experiments go, upon any picrate. It is the alkaline sulphides that possess this power, and not free sulphydric acid, a circumstance which has not been noticed, in consequence of chemists operating on solutions of picric acid in alcohol to which excess of ammonia had been added. When sulphydric acid is passed through such a solution, sulphydrate of ammonia is formed and acts on the picric acid.

Sulphydric acid may be passed through solutions of picric acid, picrate of potash or picrate of ammonia, either at ordinary temperatures, or at a boiling heat, for any length of time, without producing the slightest effect. On the addition of excess of alkali the reducing effect of the sulphide formed is immediate.—*American Journal of Science and Art.*

On the Presence of Nitrates in Mineral Waters, and on the Production of Saltpetre, by R. Haines, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

(*Continued from page* 166.)

In confirmation of the above view, I will mention the result of an analysis of a nitre-yielding earth, which was sent me from Patree, in Guzerat,—the only substance of the kind I have had the opportunity of examining. It is said to occur in a space of limited breadth, extending from East to West, and not elevated. It was not a general sample of the soil, but the rich surface sweepings which contained the saline efflorescence. This earth contained the large proportion of 26·207 per cent. of soluble salts, the per-centage composition of which was as follows:—

Chloride of sodium . .	56·507
Nitrate of soda . . .	24·126
Nitrate of potassa . .	8·631
Sulphate of magnesia . .	5·284
Sulphate of lime . . .	5·452
	100·000

Here it will be observed that although the total nitrates amounted to nearly 33 per cent. of the soluble matters, yet the nitrate of potassa was little more than a fourth of this, the greater part of the nitric acid being in combination with soda; and the disproportion is even greater than appears at first sight, as from the lower equivalent of soda, the nitrate of soda contains, proportionally, more nitric acid than that of potassa; the 24·126 parts of the former containing 15·327, the 8·63 of the latter but 4·615 of nitric acid. By the ordinary mode of crystallisation, the greater part of the nitrate of soda would remain in the mother-liquor, and be thrown away. The remedy is simple enough in theory,—viz., to add potash salts, or wood ashes, which always contain them, whence, by double decomposition, nitrate of potassa and a soluble salt of soda will be formed. I recommended a trial of this plan, but I have not heard anything of the result. It is the general practice in preparing saltpetre by the artificial method in Europe to add carbonate of potassa to the crude solution as long as a precipitate of carbonates of lime and magnesia is formed, or, what comes to the same thing, until the liquor acquires an alkaline reaction. The liquid contains the nitrates chiefly of these bases, and the cessation of the precipitation marks the term of the decomposition; but when nitrate of soda is to be decomposed by these means, the manufacturer has no such guide to assist him. No precipitation occurs, and the first addition of potash renders the liquid alkaline, so that he must be content with noting the specific gravity of his crude liquor, and adding as much potassa as experience shall show him to be the minimum quantity requisite to increase the yield of nitre to the utmost. The most economical plan would appear to me to be, to add a portion of wood ashes to the earth under lixiviation; and then, when all the saltpetre has crystallised out in the ordinary way, to stir into the mother-liquors sufficient wood ashes to make the mass nearly solid, and to dry it with a pretty strong heat. The nitrates would thus be fully preserved in a portable, and not deliquescent form, and the extraction of the salts could be performed elsewhere; while, even if an excess of ashes were used, their potash salts could be made available by the manufacturer, and would be worth the carriage. I regret not having paid attention at the time to the insoluble matters. I have searched for recorded analyses of a similar kind, but, to my surprise, I have been only able to find two old ones, by Dr. John Davy. One of the surface earth of the saltpetre-producing cavern of Memoona, in Ceylon, the other of the saltpetre earth of Tirhoot, in Upper Bengal,[1] and one by Mr. Stevenson, also, of saltpetre earth from the Tirhoot district,[2] the latter being an average sample of the ordinary soil, while that analysed by Dr. Davy was from the rich surface collections.

	Analysis of earth.			100 parts of soluble salts consisted of		
	Memoona (Davy.)	Tirhoot.		Memoona.	Tirhoot.	
		Davy.	Steven-son.		Davy.	Steven-son.
Nitrate of Potassa ..	2·4	8·3	0·7	72·7	63·8	12·3
,, Magnesia ..	0·7	..	..	21·2	..	..
,, Lime	..	3·7	0·9	..	28·5	15·8
Sulphate of Soda ..	..	..	2·7	..	..	47·4
,, Magnesia ..	0·2	..	..	6·1	..	..
,, Lime ..	..	0·8	..	..	6·2	..
Chloride of Sodium ..	..	0·2	1·4	..	1·5	24·5
Carbonate of Lime ..	26·5	35·0	44·3	..	..	..
Water and organic matter	9·4	12·0	..	..	..	..
Matter insoluble in nitric acid	60·8	40·0	50·0	..	..	..
Total	100·0	100·0	100·0	100·0	100·0	100·0

Lavoisier states that different samples of natural saltpetre in France yielded him, after treatment with potashes, from $1\frac{1}{4}$ to $5\frac{3}{8}$ per cent. of nitrate of potassa. Ragsky lately examined numerous samples of saltpetre earth (surface-sweepings) from Hungary, and found from 0·50 to 2·33 per cent. of nitrate of potassa. (In Hungary, an earth which yields 0·26 per cent. only, is said to be rich.) The most remarkable thing in Davy's analyses, given above, is the almost total absence of chloride of sodium, and, indeed, of all soda salts whatever. Another notable circumstance is, that the richest earths of France and Hungary cannot be compared for productiveness with the random samples of Indian earths.

On referring to Mr. Stevenson's paper, I find that it partly answers one of the questions that occurred to me, or at least gives some assistance towards answering it;

[1] Knapp's "Chemical Technology," i. 347.

[2] "Journal of Asiatic Society of Bengal," ii. (1833) 23.—"On the Manufacture of Saltpetre, as practised by the Natives of Tirhoot. By Mr. J. Stevenson, Superintendent Hon. Co.'s Saltpetre Factories in Behar."

and the statements are so much to the purpose, that perhaps I may be excused for quoting them:—

"The soil of Tirhoot almost everywhere contains a large proportion of saline matter, such as nitrate of potass (saltpetre), nitrate of lime, sulphate and muriate of soda, &c.,[3] but in general, the muriate of soda is most abundant. The saltpetre (as well as the other salts) lies in patches, as it were, some parts being more productive than others, according as carbonate of lime or sand alternately predominate. By analysing the different soils, I have found those places most productive of nitre to contain a redundancy of the former; and, on the contrary, where the soil was unproductive, I found a redundancy of the latter substance. I am, therefore, naturally led to the conclusion that carbonate of lime is one of the principal agents in the production of this article. This will also account for the district of Tirhoot being more productive of nitre than any other place in India, for almost half of its soil is calcareous."

Mr. Stevenson's observations, therefore, remarkably corroborate the views of Kuhlmann and others, as to the agency of carbonate of lime in nitrification; but, may we ask, is limestone essential? Cannot the nitric acid be formed and combine directly with potassa or soda, as well as by the indirect process suggested by Kuhlmann? Is there in potassa any peculiar property or affinity which makes the combination of nitric acid with it more frequently observed than that with soda? or is it merely that the collateral agencies which determine nitrification happen, by some combination of circumstances, to be more frequently present when there is potassa in the soil than when there is soda? or is the fact simply that nitrate of soda, when it does occur, is often overlooked altogether? Is limestone absent from the soils which yield *sujjee muttee* or native carbonate of soda?[4] Is nitrate of soda never found in this soil, either when it is calcareous or when not calcareous? What is the source of the carbonate of soda itself? Could a solution of potassa or soda be substituted for milk of lime in Collard de Martigny's experiments with equal success?

With these queries I conclude, hoping to call the attention of those interested in developing the resources of India to these points, which are not only of scientific interest, but also (I think) of no little practical utility.—*Transactions of the Medical and Physical Society of Bombay.*

On the Chemical Composition of Steel.

DR. CRACE CALVERT read a short paper on this subject at the meeting of the British Association. He said it was only of late that chemists had attempted to investigate the composition of steel, though it was one of the highest importance to manufacturers. Science, however, had not rendered the service that was anticipated. The nature and properties of steel were so different to iron, that chemists had not progressed in regard to its composition as might have been expected. There was a very warm discussion going on now between chemists on the Continent, one party contending that nitrogen was an essential agent in converting iron into steel, and the other party that nitrogen was not at all necessary, and that carbon was alone essential. He (Professor Calvert) had made one observation which he thought would interest the chemists assembled in Manchester. For the last two or three years he had devoted considerable attention to the carbon existing in cast iron. In treating cast iron with a weak acid he had succeeded in removing 75 per cent. of the metal, leaving a light graphitic mass, composed of silicum, carbon, and nitrogen. What was exceedingly interesting was that this cast iron contained 1 per cent. of nitrogen, a body which chemists did not actually know existed in it, though its presence was suspected. It occurred to him that if a weak acid enabled him to get at this carbon in cast iron, it would be interesting to see what carbon there was in steel, and possibly he might come to the point in discussion amongst the Continental chemists. In making his experiments he came to this interesting fact, that the different properties which steel acquired by tempering was not a mere molecular change, but a complete chemical change took place during the moment. He took two pieces of the same steel, one soft and the other hardened. Both were placed at the same time in weak acetic acid. The hard steel now was nearly dissolved, whilst the soft steel remained nearly in the same state as when put in. The hard steel was covered with carbon, having the appearance of lamp-black; whilst on the soft steel the carburet of iron was perfectly grey, and was composed of carbon, iron, and perhaps nitrogen. He hoped, with future experiments, to be able to throw more light on this subject.

On the Estimation of Nitrogen, and on an Acidimetric Process, by M. CAREY LEA.

IN a late number of the CHEMICAL NEWS[1] a modification of Will and Varrentrapp's process for the estimation of nitrogen is proposed by Mr. J. Walker. He decomposes the substance in a combustion tube in the ordinary way, but instead of conducting the products of the combustion into chlorhydric acid, conducts them into solution of chloride of zinc, and in place of determining the ammonia in the usual manner, determines the amount of oxide of zinc precipitated by it. "This process," the author observes, "has been practised by me for the last two years, and gives most accurate results, and I can with perfect confidence recommend it."

Few chemists would be apt to adopt a process so obviously worthless, but as its author recommends it especially for the analysis of manures, and as in that way it might be employed for technical purposes, it seems desirable that its gross inaccuracy should be pointed out. Oxide of zinc is well known to be easily soluble in ammonia salts; if a drop of caustic ammonia is let to fall into a solution of pure neutral chloride of zinc, it occasions a precipitate of oxide; if now solution of sal-ammoniac be added, the precipitate redissolves. Obviously, if more ammonia instead of sal-ammoniac is added, sal-ammoniac is formed by the decomposition of the zinc salt, and a portion of the precipitate is redissolved by it, or, to speak more correctly, a portion of the oxide of zinc which is liberated by the ammonia is held in solution by the sal-ammoniac. The necessary result must be an under-estimation of the ammonia, leading to

[3] "I have not been able to ascertain whether the *sujjee muttee* (native carbonate of soda) is found in this district; as far as my own observations have extended, it does not form a part of the composition of the soil. I also could not detect any alumina, though it is likely some parts may contain it."

[4] In the Madras Presidency limestone does accompany the native carbonate of soda,—"A thick bed of lime frequently occurs at the depth of six or eight feet from the surface, covered by the dhoby's earth. The natives appear to be aware of this, and frequently dig in such localities in search of lime."—Hunter's "Indian Journal of Arts," &c., i. 432.

[1] Nov. 24, 1860, p. 280.

errors of such magnitude as would render the process wholly unfit even for the roughest technical process.

In consequence of overlooking the frequent solubility in alkaline solutions of certain metallic oxides and basic salts insoluble in water, even chemists of experience have been led into singular errors. Dr. Friedrich Mohr, in his interesting book on "Volumetric Analysis," highly recommends a process proposed by Kieffer for acidimetric estimation, and which is briefly as follows:—Sulphate of copper in solution is treated with liquid ammonia until the precipitate formed is nearly re-dissolved; it is then filtered, diluted to a certain strength, and constitutes the test liquid If this be dropped into an acid, or an acid solution, after the addition of a certain quantity a precipitate falls, the appearance of which Kieffer and Dr. Mohr consider to mark the moment of the exact saturation of the acid liquid by the joint action of the ammonia and copper. Dr. Mohr observes[2]:—

"Donc le moindre excès de la liqueur de dosage formera un précipité bien net, tout à fait insoluble dans la dissolution des deux sels complétement neutres."[3]

Here is an important error, this precipitate is by no means insoluble in such solutions, it is soluble with considerable facility in solution of sulphate of ammonia (in the above passage Dr. Mohr refers more particularly to the dosing of sulphuric acid), and also, though to, perhaps, not so great an extent, in solution of sal-ammoniac and of nitrate of ammonia. Consequently, when the precipitate appears, it is because the solution is saturated with it. If it were not that the effect of the cupro-ammoniacal solution is directed to be determined empirically and not by calculation, this solubility would have led to discrepancies no doubt sufficiently great to have awakened suspicion. But the error is just sufficiently great to make the process dangerous. More or less of the precipitate is held in solution according as the saline solution is more or less dilute. Consequently, if the liquid to be analysed contains no saline matter, the error may be but trifling, the error in the analysis correcting more or less accurately the original error in the determination of the "titre." This mode of estimation is particularly recommended for determining the quantity of free acid in acid saline solutions; but here is just where it would be most fallible, the nature and quantity of the saline substance in solution exerting a powerful influence on the solubility of the precipitate. It is evident that a solution containing five grammes of free sulphuric acid with five grammes of sulphate of ammonia, tested in this way, would give quite a different result from one in which five grammes of free acid was contained with twenty or fifty of sulphate of ammonia. Likewise its results when used in the "method of residues" must be false. Accordingly, in an experimental trial by Dr. Mohr[4] for the determination of magnesia by supersaturation, with a known quantity of sulphuric acid, and determination of the residue of uncombined acid, the result which he obtained is erroneous by four per cent. Four per cent. too little of magnesia were obtained, because the free sulphuric acid was over-estimated, the ammonio-cupric solution having been added till a precipitate was obtained, which, as we have just seen, does not fall till after the saturation point has been reached.

The precipitate which appears in all these cases is spoken of by Dr. Mohr as hydrated oxide of copper. It appears to be basic (probably quadribasic) sulphate.

In making these observations on a single process of Dr. Mohr, I wish, at the same time, to bear testimony as to the candour with which he has given the results of his experimental trials. The proposal of a mode of analysis such as that of Mr. Walker is a new proof how much it is to be regretted that any chemist should offer a new mode of analysis without having first controlled it by the analysis of one or more specimens of substance of a known composition. In this way MM. Glénard and Guillermond have recently proposed[5] a method of estimating the quinine in barks. It has been, however, shown,[6] that not only the presence of cinchonine destroyed the accuracy of these results, but that, owing to a mistake of the authors as to the reaction of the sulphates of quinine upon tincture of logwood, the process when performed with pure quinine gave only one-half the true result.

In connection with the foregoing observations on zinc I may remark, that an error has crept into the description of zinc reactions in Gmelin's "Handbook." It is there stated that zinc salts give precipitates with ferrocyanide and ferridcyanide of potassium, both of which are soluble in chlorhydric acid.[7] As respects the precipitate with ferrocyanide, this is certainly erroneous, the precipitate does not redissolve in that acid.—*American Journal of Science.*

On some New Aniline Colours,

by W. CROSSLEY, *Analytical Chemist, Middlesborough.*

IF aniline be mixed with bisulphide of carbon, and allowed to stand for some days, sulphuretted hydrogen is evolved and a cream-coloured, fatty-looking body left. If a little fuming nitric acid be carefully added to this, a beautiful crimson-coloured substance, along with a dirty-brown body, will be produced. I have found no good method for separating the two. But if a portion is first dissolved by boiling in alcohol, and then fuming nitric acid carefully added, drop by drop, a crimson-coloured fluid is produced, which dyes either woollen, silk, or cotton, although they take it more readily if it be first slightly acidified with sulphuric acid. Again, by dissolving the above-mentioned fatty substance in benzole and treating with nitric acid, a fluid is produced which may be used for dyeing lemon-colour. I ought to mention that if either the solution in alcohol or benzole be allowed to cool before the nitric acid is added, a large quantity of clear crystals will separate.

None of the above colours rival, or even equal, those already known, but the reactions are interesting, and I think them worthy that attention which I, from press of other business, am unable to give.

Chemical Prize.—A Gold Medal, worth 600 francs (23*l.* 16s.), is offered by the Utrecht Society of Sciences, for a memoir on *The Rigorous Determination of the Atomic Weight of at least two Elements among those on which M. Stas has not yet published Researches.* The memoir must be sent before November 30, 1862, to Dr. J. W. Gunning, the Secretary of the Society, Utrecht.

[2] Not having a German copy at hand, I quote from the French translation made by Forthomme under the superintendence of Dr. Mohr.

[3] Forthomme's translation, p. 409.

[4] *Op. cit.*, p. 412.

[5] "Rep. de Chimie Appliquée," 1859, p. 131.

[6] *Idem*, 1860, p. 61.

[7] Handbook, Vol. v., p. 12, Cavendish Edition.

TECHNICAL CHEMISTRY.

Notes on the Naphthaline Colours, by Charles R. C. Tichborne.

As the investigations of M. Z. Roussin are now attracting some attention, I may be excused for mentioning some peculiarities observed by myself during a repetition of his experiments, particularly as there has been very little published as yet regarding the manipulatory *minutiæ*. Presuming, therefore, that the readers are already acquainted with the general *modus operandi* of his "artificial alizarine" experiments, I wish to point out some few difficulties which strike me on looking back at a *resumé* of my working, the overcoming of which are imperatively necessary to ensure success.

M. Roussin directs the binitronaphthaline and sulphuric acid to be mixed together, and then to be heated to 392° F. Now, as this is a great temperature, and generally requires some time to raise it to the requisite point when operating on a large scale, I think it preferable to heat the sulphuric acid nearly to 400° F. before adding the naphthalic compound, by which means a considerable loss of the latter substance is avoided. If this plan be not adopted, the temperature should be raised as quickly as possible to 392° F., but, as will be shown, on no account should the reducing agent be added until that point be reached. In the original memoir we are told to add the reducing bodies in successive portions, at a time when the menstruum has arrived at 392° F.; upon proper attention to this part of the process the entire success of the operation depends. The colouring matter is, in a measure, slowly formed at a lower temperature than that specified, so that on adding a quantity of the reducing agent it will under such circumstances produce a considerable amount; but from the chemical action sufficient heat is invariably generated after some time to bring it much above the stipulated point; when such is the case, a violent action sets in which is completely beyond control.

When the mixture is at 400° F., and not before, it should be taken off the heating medium, and the reducing agent in a state of fine division added in small proportions at a time, the whole being constantly stirred. A little heat may be again employed if the thermometer seems inclined to fall. By attention to these injunctions the action sets in at once on the first addition, and proceeds in a quiet and uniform manner; the heat generated (although being expended in a great measure) is generally sufficient to keep up the temperature.

The question was mooted at one of the late meetings of the British Association at Manchester, whether colouring matters could be procured from naphthaline at all, and whether such matters were not aniline products produced from the use of an impure hydro-carbon; and I believe, although I had not the pleasure of attending those meetings, that the statement was made that the colours could not be made from pure naphthaline. That this is a mistake is evident from the composition of M. Roussin's so-called alizarine, and because I have succeeded equally well with the chemically pure naphthaline. To procure this compound I took the ordinary article and re-crystallised it from an alcoholic solution acidulated with acetic acid. These crystals, on being re-dissolved in alcohol, were precipitated with distilled water and thoroughly washed. When boiled with acidulated water, which was afterwards concentrated and tested, it was found perfectly free from aniline. When dry I projected it, a small portion at a time, into 4 times its weight of pure nitric acid (specific gravity 1·500); this gave about 1½ part of pure binitronaphthaline. The mother liquors which first drained from the crystals gave a precipitate on dilution with water, which, however, seemed to contain other compounds. On the further treatment with sulphuric acid and tin, the so-called artificial alizarine was procured in considerable quantities. The direct extraction of this colouring substance may be brought about in the following simple manner:—After boiling some minutes with water, it should be as nearly neutralised as possible with a solution of potash, and the resulting precipitate thrown upon a calico filter; as soon as it is thoroughly drained, the dye may be extracted from the black mass by hot methylated spirit, to the amount of about 60 to 70 per cent.

M. Dumas, in bringing M. Roussin's communication before the French Academy, said, that as the author had not at present given an analysis of the new product, its identity with alizarine was not yet proved, and I am not aware that one has been since published. I cannot myself supply the void, at at present I have not succeeded in isolating it in a sufficient state of purity for analysis, but I have no hesitation in saying that it is destitute of nitrogen, and therefore can have no connection with any of the aniline colours. *Vide* the different analyses of those substances already published.[1] This can be proved by taking a solution of the colouring matter in potash, and evaporating to dryness on a water-bath to expel the least trace of ammonia, and then testing by Lassaigne's method—*id est*, by fusing with potassium, &c. The result is—no indication of the presence of nitrogen. But when this experiment is tried, and a small quantity of mauvè or fuschsine added, the presence of Prussian blue is immediately exhibited.

I found that when binitronaphthaline was intimately mixed with *Hepar sulphuris*, and the mass slightly moistened with water, the whole of the naphthalic substance was converted into a most brilliant colour on the application of heat; but on going the following morning to examine this apparently cheap and easy method of procuring a splendid dye, I found my bird had flown, and the colour entirely faded.

On further investigation I found that this was due to the presence of the alkaline hyposulphite,—the hyposulphites instantly bleaching the naphthaline colours; but by subjecting the *Hepar sulphuris* to great heat, and so converting it entirely into penta-sulphides and sulphate, the difficulty is nearly overcome; and I have great hopes that this process may be practically turned to account. But the purest red, I got in an experiment in which I tried the direct reducing action of protoxide of iron upon binitronaphthaline,—*id est*, by treating the latter substance with proto-sulphate of iron and an excess of potash.

As M. Roussin states, a blue colour is easily procured by the action of cyanide of potassium upon binitronaphthaline, but it is not a very pure blue, and presents a slight greenish shade This substance dyes a brilliant green on the addition of a small quantity of dinitraniline. Dinitraphenic acid and the other yellow tar products are not applicable.

There have been few technical discoveries within the last few years which have created so much excitement amongst the *savants* and the public at large as the aniline dyes, not only from the scientific interest attached

[1] Béchamp's fuschsine $C_{12}H_{12}N_2O$. Phenamein (the name given to aniline violet by Scheurer-Kestner) $C_{30}H_{14}N_2O_2$.

to such disclosures, but also, as the President of the British Association intimated in his inaugural speech this year, because no doubt, in time to come, instead of being dependent upon other countries for our supply of dyeing materials, we should become an exporting nation to supply the wants of other kingdoms,[2] the advantages being, not only independence of foreign importation, but the opening of entirely new branches of trade, in which branches our old acquaintance King Coal is still our friend, and gives us preeminent standing in working this new mine of wealth.

If aniline opened such a field before us, how much more bright must be the prospect that the naphthalic colours present. The price of aniline being still very high, in spite of all the attention devoted to its cheap production. Nor is there the least probability of a cheaper result. But here is naphthaline, at one time the curse of the tar distillers, become an article of vast importance, although formerly it was frequently the case that they were compelled to bury this unprofitable acquaintance.

Laboratory, Apothecaries' Hall of Ireland.

PHARMACY, TOXICOLOGY, &c.

On the Active Principle of Cornus Florida, by John M. Maisch.

No complete analysis has as yet been made of the barks of the various species of cornus. In Vol. vii. p. 109, of the *American Journal of Pharmacy*, Mr. James Cockburn details the results of a number of experiments made with the bark of cornus Florida, which are not without interest, but leave us in the dark about the nature of the true active principle of this indigenous tree. This is ascribed by him and by other investigators to "bitter extractive," a name which has to cover a multitude of compounds, difficult to isolate.

In compliance with the subject accepted by me for investigation for the American Pharmaceutical Association, I have directed my efforts principally to the isolation of the active part of this bark, without taking much notice of the other principles it contains; but it was necessary first to obtain some information about these other constituents.

I have therefore repeated and variously modified some of the experiments made by Mr. Cockburn, and find them mainly correct; I was unable, however, to obtain the crystalline substance of which he speaks, and for which I did not search any farther, as these crystals are stated to be entirely tasteless, and my main object lay in a wholly different direction.

Alcohol and water both extract completely the bitter taste of the bark of cornus florida, leaving a tasteless residue which imparts no taste to a diluted acid. It is therefore unnecessary, for the extraction of the bitter principle, to contaminate the exhausting liquid with a foreign acid, which would serve no other purpose except to require to be removed again. By extracting the bark with alcohol, the tannin, resin, some waxy matter, free acid, &c., are taken up and interfere with the purification of the extract. Water dissolves no resin, wax, or fatty matter, but on the other hand takes up some gum which may be easily got rid of. Alcohol and water dissolve the whole of the colouring matter.

The neutralisation of the free acid, contained in the infusion and tincture, does not visibly affect the appearance of the liquid; an excess of alkali deepens the colour somewhat, without otherwise disturbing it; alkalies cause no precipitate of the bitter principle. It was to be inferred, inasmuch as most alkalies are but sparingly soluble in water, that the bitter principle was not of an alkaline nature. If it is of neutral behaviour, the aim, it appeared, must be to remove the other substances so as to retain the bitter active body in solution; or else, take it up by a solvent, which leaves the other bodies behind.

Without attempting to enter into detail on the various experiments made for this purpose, I may as well state the result of my investigations, giving some explanations afterwards.

I have succeeded in obtaining the bitter principle of the bark of cornus florida in a perfectly colourless and neutral solution; but all attempts to evaporate the liquid without decomposition have signally failed. No matter whether the alcoholic or the aqueous colourless solution is evaporated by rapid boiling, at a moderate heat, at ordinary temperature, in a current of dry air or over sulphuric acid under a bell glass, in all cases a brownish colour is produced, which is deepened as the liquor is concentrated, and a dark brown extract is left behind without the least sign of crystallization.

This colourless solution of the active principle may be obtained in various ways; I have found the following to be the least troublesome:—

Coarsely powdered dogwood bark is twice boiled with water, and the expressed clear liquid is precipitated by solution of subacetate of lead; a flesh-coloured curdy precipitate takes place, which, on stirring becomes very voluminous, and now contains the tannic and gallic acids, gum, colouring matter, &c. The liquid, which is filtered off from the precipitate, is destitute of colour, and contains the bitter principle, together with free acetic acid, and an excess of the precipitant. The excess of lead may be removed in various ways, either by a little sulphuric acid, or by sulphuretted hydrogen; if sulphuret of ammonia, or an alkaline carbonate is used, the alkali serves to neutralise the free acid; the former precipitants require the subsequent use of an alkali to saturate the acid.

Now, in whichever way the lead has been removed and the acid neutralised, the solution remains colourless and neutral for some time at ordinary temperature; but if it continues in contact with the air, and is allowed to evaporate, a decomposition takes place and an extract remains behind, which is still of a neutral reaction, if for the neutralisation of the free acetic acid a fixed alkali has been employed; if, however, ammonia has been used, the extract will have a slight acid reaction from the formation of the acid acetate of ammonia, and the expulsion of some of this volatile base. When evaporated to a syrupy consistence, and now mixed with strong alcohol, the whole liquid is redissolved, with the exception of a white crystalline precipitate of alkaline acetates, and sulphates. All the colouring matter goes into solution, and on evaporation a bitter extractive mass remains, which is wholly soluble in water and alcohol. Its solution is again precipitated and decolorised by subacetate of lead, and the filtrate has now the same behaviour as in the first instance.

By digesting the decoction with carbonate of lead, litharge, or hydrated oxide of lead, the tannic acid of the dogwood bark is precipitated, but at the same time the liquid is rendered turbid by keeping some lead in suspension, which is not removed by filtration; as it

[2] "It is more than probable that England, instead of drawing her dye stuffs from foreign countries, may herself becomethe centre from which all the world will be supplied."—*Mr. Fairbairn's Speech.*

passes the filter the liquid is still turbid, and to render it clear, requires to be treated with sulphuric acid or sulphuretted hydrogen, in order to precipitate the lead, which at the same time throws down a considerable amount of colouring matter, but leaves the filtrate still with a decidedly brown colour, which cannot be removed in this way.

A similar result is obtained if the removal of the tannin is attempted by precipitating it with gelatine; the whole amount is not very readily thrown down, and the filtrate has retained a good part of its colouring matter.

More completely than by the latter two ways will the decoction be decolorised by first dissolving in it some alum, and precipitating it again by one of the alkalies, or their carbonates. The alumina which precipitates, will also carry down all colouring matter and tannin, so as to yield a clear colourless filtrate, which, besides the excess of the saline additions, contains the whole of the bitter principle. If this solution is now evaporated, the same change takes place with the organic matter; it turns dark; from the syrupy residue, the saline admixtures are thrown down by strong alcohol, but the colouring matter is dissolved, and, on evaporation, a bitter extract is left behind, without any traces of crystals. The extract, dissolved in water, and treated with alum and an alkali as before mentioned, again yields an almost colourless solution, which shows the same behaviour as before.

In the above experiments, after the bitter principle had been repeatedly deodorised and evaporated, the precipitates of lead or alumina would not carry down the whole of the colouring matter, but leave the filtrate of a yellowish colour, which grew deeper with a repetition of the experiment; the bitter taste of the resulting tincture and extract was now perceptibly less marked, and had nearly entirely disappeared in two specimens of extract, which had been thus treated, and afterwards kept for six months exposed to the air.

I have mentioned above in which various ways I attempted to evaporate the clear solution, so as to prevent change, and it is unnecessary to dwell more upon this matter, as the result has been nearly the same, the chief difference being a somewhat higher or less degree of colour.

A number of experiments were undertaken with the view of obtaining a precipitate from the colourless solution, which should contain the bitter principle; but all attempts have so far been fruitless. It was thought that an ethereal solution might be less likely to become coloured, as its evaporation might be carried on at a very low temperature, and the ether itself would act as as a deoxidizer. But no such solution could be effected; ether would not take up the bitter principle from water or alcohol, nor would it cause its precipitation from the spirituous solution.

The presence of free alkalies or acids, during evaporation, appears to hasten the change of the bitter principle; the solution resumes a colour of a marked deeper tint, and the peculiar odour exhaled from a decoction of dogwood bark, seems to be stronger.

If I may be justified to deduce any inferences from the results of the experiments as stated above, they would be as follows:—

The bitter principle of the bark of cornus Florida is a colourless, neuter, persistently bitter substance, which is very soluble in water and alcohol, insoluble in ether, not precipitated by chemical re-agents, but very easily affected and destroyed by exposure to the air.

This at the same time furnishes an answer to the other question propounded to me; my inability to obtain the active principle in a pure state rendered a comparison with quinia impossible.

My experiments imply some useful hints regarding the mode of making pharmaceutical preparations of dogwood bark. Contact with the air and exposure to heat, it would appear, must be avoided; a solid extract is best evaporated in vacuo; in preparing a fluid extract, the liquid ought to be brought under the protective influence of sugar as soon as possible. For such preparations, water is a better exhausting menstruum than alcohol, which would take up inert resinous matter; this, in its pure state, is almost white, crummy, soluble in alcohol and ether, also, in alkalies; destroyed upon platina foil without fusion, leaving much charcoal; it is tasteless, and apparently without influence on the human body.

Although having failed so far in my attempts to isolate the bitter principle of cornus florida in a crystalline state, I intend to institute further researches upon this subject, the results of which I may probably lay before the Association, if they should prove to be new and more satisfactory. The isolated principle will, no doubt, be interesting, but, I suppose, of little practical value, if we are to judge by the above properties.

I may remark yet, that I have also somewhat experimented with the bark of cornus sericea, but with no better result.

PHYSICAL SCIENCE.

How to make a Gyroscope.

A simple Gyroscope may readily be made from a "patent metal top." Fig. 1 represents a section of one of these

Fig. 1.

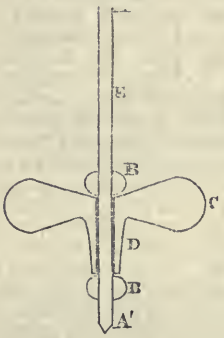
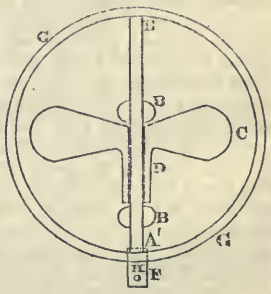


Fig. 2.



latter: it consists of a heavy wheel, C D, revolving round a rod, A A', and kept in its place by projecting pieces of metal, B B. Motion is given to C D by rapidly unwinding string from D, and if the top be now placed on the ground, the revolution of C D carries round the rod A A', and a continuous spinning ensues.

In order to make a gyroscope from such a top, we divide A A' at E (Fig. 1); a piece of copper wire, about one-sixth of an inch in diameter, is next formed into a circle, G G (Fig. 2), the diameter of which is equal to the distance between the opposite ends A' and E, which are soldered into it. At the point where A' touches G G, a small piece of sheet copper, F, is fixed; to this a double swivel (such as is used for pike fishing) is attached by means of a piece of string passing through the hole H.

When C D is in rapid motion, the swivel is suspended from a piece of stout wire, and becomes a centre round which the whole may revolve.

This gyroscope costs about 2s.; it works well, although, as far as appearance is concerned, it will not bear comparison with its more elegant brethren, which can boast a finely-turned copper wheel, with a steel axis smoothly revolving in a brass ring.

NOTICES OF BOOKS.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

SECOND NOTICE.

In continuation of the reports which have already been presented *in extenso* to the notice of our readers, we purpose now to enter upon a critical examination of the several projects which have been submitted for the consideration of the "Decay of Stone Committee." Many of the propositions appear to have been at once rejected, on the ground of their being altogether inapplicable to the wants of the case; in other instances the proposals could not be entertained on account of the over-anxiety displayed on the part of the inventors, lest they should betray the secret of their composition, or by objecting to the announcement of the data upon which alone a sound judgment could be based. Thus it happens that among the great number of processes suggested, only a dozen or so appear, up to the present time, to have been selected for further examination; and even these few enumerate more than one example in which the efficacy of the mode of treatment will have to be determined solely by the inspection of treated surfaces, and without the assistance likely to be derived from a full knowledge of the chemical properties of the materials actually employed.

The witness first examined by the Committee was Mr. Nicholas Charles Szerelmey, who has gained for himself some celebrity by the successful manner in which he has hitherto preserved his secret, and who still declines to communicate any more than the barest information respecting the nature of the process employed by him in coating certain external portions of the Palace at Westminster, which, from their early showing signs of decay, were put under the treatment of Mr. Szerelmey as far back as the spring of 1857. The evidence elicited during this gentleman's examination is of the most conflicting character; at one time it is affirmed that no oily nor bituminous matters had been used in the preparation of the stone, but shortly afterwards the employment of Egyptian asphaltum, from the Dead Sea, is distinctly admitted, and, as a solvent for the same, some kind of mineral oil. With regard also to oxide of zinc, Mr. Szerelmey denies that his composition contains this material, but the report of the chemists on the Committee, addressed to their Chairman, refers particularly to the presence of oxide of zinc as a constituent of the preparation applied to the Speaker's doorway. This appears, however, to have been a special ingredient used at a time when Sir Charles Barry made the suggestion to try the effect of colouring matters in conjunction with the witness's ordinary preparation.

The use of a soluble silicate as a first application forms apparently the groundwork of Mr. Szerelmey's process, and the varnish made from Egyptian asphaltum, subsequently applied, is intended to protect the silicate in the pores of the stone from the action of the atmosphere and external influences generally. Three coatings are referred to as being necessary for the successful manipulation of the process; but it does not appear whether any two of these coatings are identical in character or otherwise.

In looking now to the results of the experiments, it would appear that the four years' interval which has elapsed since their first application has demonstrated that a considerable degree of protection has been afforded to the stone; and when proper account is taken of the severity of last winter's frost, and the depth to which the stone itself must thereby have been subjected to extreme cold, there is reason to conclude that the effort of Mr. Szerelmey is at least a partial success; but in the event of its being selected among others for further experimental trial, it must surely be necessary to insist upon a candid explanation being afforded in regard to the exact nature of the ingredients actually applied to the surface of the stone.

NOTICES OF PATENTS.

361. *The Suppression of Arsenical and Sulphurous Fumes emitted during the First Operation or Calcination of Copper Ores.* E. T. JONES, Morden College, Blackheath. Dated February 13, 1861. (Not proceeded with.)

THIS invention has for its object the condensation and recovery of the arsenic and sulphur products which are given off in great abundance during the operation of roasting copper pyrites, and similar ores of that metal. The improved arrangement of apparatus consists, firstly, in the employment of large iron or clay retorts, such as are used in the manufacture of coal gas, in which retorts the roasting operation is carried on, and the volatile products escaping from the heated ore are led forward into a second or condensing arrangement, which consists of a long iron tube, about twenty feet in length, and from six to eight inches in diameter, the further end of which is made to dip just beneath the surface of water contained in a box or receptacle measuring four feet in every direction. For the effectual cooling of this part of the apparatus, a constant flow of water must be maintained in an outer cistern, within which the condenser is totally immersed; or, instead of this form of refrigerator, a one-inch leaden pipe, perforated on the lower side with small holes, and made to deliver freely a supply of cold water, may be fastened along the upper surface of the iron condensing tube. The appliances for clearing the tubes of the arsenical deposit, for receiving the heated charge from the retorts when sufficiently calcined, and other particulars relating to the mechanical arrangement, are described in the specification.

Anyone who has personally visited the copper-smelting district of Swansea, and noticed the desolation conferred upon the immediate neighbourhood by the volumes of copper smoke pouring forth night and day into the atmosphere, cannot fail to appreciate the value of any practical suggestion which will have a tendency to diminish the evil complained of, and if to this consideration be superadded the equally important question of economy, the subject becomes certainly worthy of renewed investigation in the hope of discovering really efficient means of satisfying the wants of the case. The process long since patented and worked by Mr. William Longmaid, for converting the sulphur of iron and copper ores into sulphate of soda, as a stage in the alkali manufacture, was a great effort in the right direction, but has not, so far as we are aware, met with general adoption in the case of the richer ores of copper. The method of proceeding referred to in the specification above, does not appear to take sufficiently into account the necessity for establishing a powerful current of air through the roasting furnace, in order to facilitate the oxidation and expulsion of the sulphur from the ore.

376. *Manufacture of White Lead, Zinc White, and Glazier's or Potter's Lead.* T. CORLEY. Dated February 14, 1861. (Not proceeded with.)

FOR the purpose of communicating increased density,

greater permanence of colour, and drying properties to white lead and zinc-white pigments, the inventor proposes to subject them to the action of a solution of borax or other compound of boracic acid. Potter's glaze is by the same means rendered more fusible, and metallic lead itself considerably softened by melting with borax.

It would be difficult, we imagine, to increase the density of white lead by the introduction of borax. The use of this substance in connection with pottery is well understood in this country, and always employed whenever the character of the work will warrant its expense.

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378. *Impregnating the Atmosphere with Perfuming or Purifying Vapours.* E. Rimmel, Strand, London. Dated February 14, 1861.

The patentee claims the vaporisation or volatilisation of perfumes by mixing them with an aqueous base and obtaining the disengagement of the fragrant molecules by means of heat or steam. He also claims the disinfection of the atmosphere, and of all bodies, by means of aromatic vapours.

In reference to the means of disinfection here referred to there is a danger of assuming that the introduction of pungent aromatic vapours must necessarily counteract as they disguise the element of contagion present in a vitiated atmosphere. There is no doubt that camphor, vinegar, and other substances are really efficacious when properly applied, but such remedies do not, like chlorine, strike at the root of the evil by exerting upon the dangerous effluvia nothing short of a power of destruction.

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383. *Cure and Prevention of Toothache.* M. A. Prenslan, Liverpool. Dated February 15, 1861.

For the relief and cure of toothache the patentee uses "oil of paper" which he administers to the cavity of the tooth either by itself or upon cotton wool as a vehicle. The preparation is procured by submitting to destructive distillation in a close vessel any kind of paper made from a vegetable fibre.

This curiosity, "oil of paper," may perhaps owe any efficacy it possesses to the creasote among other tarry products resulting from its mode of formation. If the tuft of cotton wool were itself half consumed by fire before the remaining portion be applied to the tooth, perhaps equally beneficial results might follow; or would it not be better to burn it in the tooth itself?

Grants of Provisional Protection for Six Months.

2181. Charles William Siemens, Great George Street, Westminster, "Improvements in apparatus employed in connection with electric telegraphs, part of which improvements are also applicable to ascertain the heat in accessible places."—Partly a communication from Werner Siemens, Berlin.—Petitions recorded August 31, 1861.

2184. Thomas Shutt Stock, Joseph Sharp Stock, and Henry Taylor, Birmingham, "A new or improved tap or stop cock."—A communication from Allen Hill, New Orleans, U.S.

2186. William Muller, High Holborn, London, "Improvements in apparatus for roasting coffee, which improvements are also applicable to the roasting of cocoa and other vegetable matters."

2190. Alphonse Nicolas Saleres, Rue de Charonne, Paris, "Improvements in printing and colouring paper, chintz, and other fabrics, and machinery or apparatus for that purpose."

2202. Louis Rudolph Bodmer, Thavies Inn, Holborn, London, "Improvements in distilling apparatus."—A communication from Edme Alfred Egrot, Paris.—Petitions recorded September 4, 1861.

2225. William Spence, Chancery Lane, London, "Improvements in apparatus for dividing and softening vegetable fibres."—A communication from Felix Sorin, Rue des Fossés, Montmartre, Paris.

Notices to Proceed.

1233. John Chedgey, The Grove, Great Guildford Street, Southwark, "Improvement in the manufacture of glass rollers, plungers, and pipes, applicable to pumps and other uses."—Petitions recorded May 14, 1861.

1278. William Clark, Chancery Lane, London, "Improvements in electric telegraph apparatus."—A communication from Ludovic Guyot d'Arlincourt, Boulevart St. Martin, Paris.—Petitions recorded May 18, 1861.

CORRESPONDENCE.

The Phosphorescence of Decaying Organic Matter.

To the Editor of the Chemical News.

Sir,—It may prove a subject of interest to some of your subscribers, particularly to those residing in the rural districts, to know that at this period of the year some very remarkable phenomena of the phosphorescence of decaying organic matter are to be observed. A great deal has been written, and many explanations given, on the *Medusæ* and other phosphoric insects. It is also a well-known fact that many kinds of fish are phosphorescent even a few hours after they have been taken, and also that this does not apparently render them at all unfit for food, although perhaps it is the commencement of that stage when those chemical agencies which exerted all their powers to keep the body in a state of vital existence are devoted to the contrary work of decomposition.

On returning home a few evenings ago, my path lay through a wood of some ten acres in area. The sky was clouded, no moon visible, and the darkness intense. The surface of the ground presented a peculiar aspect. As far as the eye could pierce through the brushwood, a mass of vivid light covered the soil. There were no exhalations of phosphuretted hydrogen, as observed in marshy districts; but as I became accustomed to the change, I appeared to be walking over a carpet of glowworms. I accordingly stopped to examine the cause of the phenomenon; and, on stooping down, gathered several of the phosphorescent bodies which were moist and clammy; having the appearance of frosted silver, and apparently translucent throughout. On arrival at home, I transferred the materials I had collected, and which consisted of half-decayed oak and other leaves, pieces of dead grass, rotting wood and other organic matter in the first stages of decomposition, into a tray, and placed them in a dark room, when all the former phenomena became soon apparent as before. The light evolved enabled me to read printed matter when held close to the luminous bodies. After the leaves, &c., had been dried they ceased to be phosphorescent, nor did they become so on being moistened afresh with water; yet on being kept moist and exposed to the rays of the sun, they appeared to have regained their luminous properties by the next evening. During the rainless days of harvest, when no surface moisture was perceptible, the phenomena were not to be observed.—I am, &c.

Lux.

MISCELLANEOUS.

Disinfection of Sewage.—The Medical Inspector to the Westminster Burial Board, Mr. P. H. Holland, has on a recent occasion described the important results which have followed the adoption of Mr. Macdougall's process

for the deodorization of sewage. The plan has been put into operation in connexion with the town-drainage systems of Carlisle and Exeter, and is stated to have been completely successful both as regards the mitigation of a nuisance and the economical recovery of valuable manuring agents for agricultural employment. The process consists merely in the addition to the sewage of one gallon per diem of crude carbolic acid, costing, with carriage included, only 10½d a day—*i.e.* 16*l.* a year,—a sum extremely small as compared with that about to have been spent by the Boards of Health in these towns respectively for the purpose of conveying to a distance that which has hitherto proved a nuisance to the inhabitants and been subject to indictment. The apparatus for conducting the mixing process is as simple as could be desired, and the small proportion in which the disinfectant need be employed renders its application extremely economical.

The Canadian Oil Region.—A Correspondent of the *Toronto Leader* communicates some interesting particulars relative to the important discoveries of mineral oil, which have, in the course of a few months, proved a substantial source of wealth to those engaged, and opened out vast commercial relations in favour of a district which, until very recently, appears to have escaped special notice. The territory of Black Creek derives its name from a creek so-called running through the oil region. It is about half way between the eastern and western limits of Enniskillen township, distant twelve miles from Wyoming, and twenty-four from Sarnia. As we approach the Wyoming station of the Great Western Railway, the peculiar odour of the oil, which is here stored in large quantities for transmission to the eastern markets, is perceived at the distance of a mile or two if the wind happens to be favourable. At a distance of about five miles from Wyoming are the wells known as "Kelly's Wells." They are about a dozen in number, are yielding tolerably, and at one time attracted considerable attention. A refinery has been built at a cost of about 10,000 dollars, and is just now commencing operations. Arrived at the end of my journey, I found the oil region extending over a limited space. From the tests already made, the oilmen have concluded that it does not extend all over the township, as some at first supposed. Black Creek seems to be the richest territory yet discovered in Canada, and, according to some of the best authorities, it is the richest in America. Wandering along the banks and in the flats of the stream, which certainly deserves the name it bears, I at every few rods came across a well. They were in every stage of procedure. Some were just commenced, some were just finished; from many men were pumping oil into huge vats. Here let me say that the wells are of different kinds. First, there are the surface wells, so called because they are only sunk to the rock; these are for the most part on the flats of the creek. Some of them, when within a few feet of the rock, quickly fill with oil, which, with much noise and uproar of gas, bursts in from the loose gravelly substance overlying the rock. I have known wells fifty feet deep and five feet square full to the very brim with oil. Nay, I have seen it flow over the top and run away in a stream, wasting hundreds of barrels. These wells are dug large, the sides are cribbed and then puddled, so as to keep out the surface water. The oil from these wells is thicker and less pure than that from the rock wells, but a refiner told me that, though it was harder to deodorise and refine than the rock oil, yet, when manufactured, it made the best oil; having more body, it gave the best light, and burnt longer. It is also best for lubricating purposes. For rock wells they frequently sinck a well like a surface well, and then drill; but more frequently the soil is bored out with a large augur until the rock is reached, a distance varying from forty to seventy feet. Then piping like pump logs is put in and driven down snug on the rock. After this the slow process of drilling is carried on, by foot, horse power, or with steam engines, sinking from a few inches to perhaps ten feet per day, according to the nature of the rock. The character of the rock seems to vary with every well. It is generally, however, soapstone, with layers of shale, which is here in very small quantities; though at other parts of the township I have known drillers to go through fifty or sixty feet without change. There are also layers of sandstone, flint rock and sulphuret of iron; these vary in quantities at every well, though distant but a few rods. In the soapstone the oil is generally found, and at various distances from the surface. A continuation of little veins may be struck; then all at once a larger one, which may cause the oil to be forced in immense quantities out of the pipe. The quantity of oil this country is capable of producing is amazing. I have seen more oil, and a greater number of wells in operation and in course of being sunk, than I ever imagined as being in this county. I was told that, before January, 500 wells will be down. Large vats and tanks contain the oil, some of them holding as much as 1000 barrels; the largest are immense pits sunk in the stiff clay, cribbed and puddled, and these, they say, are better than wooden vats, which allow the oil to leak out, so penetrating is its nature. While I was there quietly looking on, I saw wells yield day after day from ten to fifty barrels. Estimating the wells in actual operation at 300, this would give 3000 barrels per diem at the lowest rate of production. And this, I assure you, is a small calculation; ten barrels per diem is moderate, and there will be double 300 wells before a year at the present rate of sinking. As far as I could judge, failure is the exception. Not one man in twenty who pretended to be in the oil region, failed to get oil; nor has any rock well shown signs of drying up. There is no doubt that we have at hand a source of untold wealth—an oil territory richer than any yet discovered. And, thanks to the enterprise of the Canadians, one firm in Toronto has undertaken the oil-refining business, while another is exporting it largely to Europe. Once the European market is opened, it must create an immense trade, for a substance from which are made refined toilet soaps, candles superior to wax, oil that gives a cheaper and not less beautiful light than gas, and much more convenient, and furnishing the best machine and lubricating oil yet known, must ultimately be brought into universal use.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

J. A. D.—Declined with thanks.

A. H. B.—1. See the solution for marking on zinc plate, given in our Eighty-fourth Number. 2. It is a difficult process: try distilling. 3. We do not know the work.

Constant Reader.—To precipitate chloride of silver from a composite saline solution when present in the smallest quantities:—Concentrate as much as possible by evaporation, add sulphuretted hydrogen and white of an egg, boil. The albumen in coagulating will carry down the sulphide of silver, which may afterwards be treated by cupellation. Silver can in this manner be detected in sea water.

Red Gauntlet.—1. Allow strong ammonia to digest with metallic copper in fine turnings, with free access of air. 2. For a description of the mode of preparing artificial malachite, see our Second Volume, page 279. 3. We do not think an ether is known which has the odour of rose or patchouli.

Book Received.—A Manual of Chemistry, Descriptive and Theoretical, by William Odling, M.B., F.R.S., &c. &c. Part 1. London: Longman, Green, Longman, and Roberts. 1861.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Classification of Organic Substances by Series, by JAMES SCHIEL, *of St. Louis.*

(*Concluded from page* 192.)

The acids form quite a number of generic series.

Series of Acids I.

$C_nH_{2n}O_2$ fatty acids n = 1 to n = 30.
$C_nH_{2n}O_3$ glycolic acid n = 2.
$C_nH_{2n}O_4$ glyceric acid n = 3 (isomeric with lactic acid).
⋮

The acids of this generic series correspond to the first alcoholic series.

Series of Acids II.

$C_nH_{2n-2}O_2$
$C_nH_{2n-2}O_3$
$C_nH_{2n-2}O_4$
$C_nH_{2n-2}O_5$

The special homologous series deriving from this generic series are,

$C_3H_4O_2$ acrylic acid.	$C_2H_2O_3$ glyoxylic acid
$C_4H_6O_2$ crotonic ,,	$C_3H_4O_4$ pyroracemic acid
$C_5H_8O_2$ angelic ,,	⋮
&c. &c.	
$C_2H_2O_4$ oxalic ,,	$C_3H_4O_5$ tartronic acid
$C_3H_4O_4$ malonic ,,	$C_4H_6O_5$ malic ,,
$C_4H_6O_4$ succinic ,,	⋮
$C_5H_8O_4$ lipic ,,	
&c. &c.	
$C_4H_6O_6$ tartaric ,,	$C_6H_{10}O_8$ mucic ,,
⋮	

Series of Acids III.

$C_nH_{2n-4}O_2$
$C_nH_{2n-4}O_3$
$C_nH_{2n-4}O_4$
$C_nH_{2n-4}O_5$
⋮

From this generic series are derived :—

$C_6H_8O_2$ sorbic acid.	$C_3H_2O_5$ mesoxalic acid.
$C_4H_4O_4$ maleinic acid.	$C_6H_5O_7$ citric acid.
$C_5H_6O_4$ itaconic ,,	
$C_6H_8O_4$?	
$C_7H_{10}O_4$ terebinic ,,	

Series of Acids IV.

$C_nH_{2n-6}O_2$
$C_nH_{2n-6}O_3$
$C_nH_{2n-6}O_4$
$C_nH_{2n-6}O_5$

From this generic series we derive :—

$C_6H_6O_2$ oxyphenic acid.	$C_5H_4O_3$ pyromucic acid.
$C_8H_{10}O_2$ terebentilic ,,	$C_6H_6O_3$ pyrogallic ,,
	$C_7H_8O_3$ ipecacuanic ,,
	$C_8H_{10}O_3$ ricinoleic ,,
$C_4H_2O_4$ mellitic acid.	$C_6H_6O_5$ aconitic acid.[1]
$C_3H_{10}O_4$ cholesteric ,,	

Series of Acids V.

$C_nH_{2n-8}O_2$
$C_nH_{2n-8}O_3$
$C_nH_{2n-8}O_4$
$C_nH_{2n-8}O_5$
⋮

From this generic series we derive :—

$C_7H_6O_2$ benzoic acid.	$C_5H_2O_5$ krokonic acid.
$C_8H_8O_2$ toluylic ,,	$C_6H_4O_5$ comenic ,,
$C_9H_{10}O_2$?	$C_7H_6O_5$ gallic ,,
$C_{10}H_{12}O_2$ cuminic ,,	$C_{24}H_{10}O_5$ cholic ,,
	$C_7H_6O_3$ salicilic ,,
$C_8H_8O_6$ phenoxacetic ,,	$C_8H_8O_3$ anisic ,,
	$C_9H_{10}O_3$ phloretinic ,,
$C_8H_8O_4$ lecanoric ,,	$C_9H_{10}O_4$ veratric ,,

Series of Acids VI.

$C_nH_{2n-10}O_2$
$C_nH_{2n-10}O_2$
$C_nH_{2n-10}O_2$
⋮

Of the acids deriving from this generic series only a few are known as yet.

$C_9H_8O_3$ cumaric acid.	$C_7H_4O_7$ mionic acid.
$C_8H_6O_4$ phtalic acid.	
$C_{24}H_{38}O_4$ choloidic ,,	
$C_{25}H_{40}O_4$ hyocholic ,,	

From other known acids it is hardly possible to form series, as they stand mostly isolated; there is, for instance, only one acid—auemonic acid $C_{15}H_{14}O_7$—

[1] The radical of the tribasic aconitic acid $\left.\begin{matrix} C_6'''H_3O_3 \\ H_3 \end{matrix}\right\} O_3$ may be derived from a hydrocarburet by substitution of H_6 by O_3, as acetic acid is formed by substitution of H_2 by O in the radical C_2H_5. The triacid alcohol, or glycerin corresponding to aconitic acid, would therefore be $\left.\begin{matrix} C_6H_9 \\ H_3 \end{matrix}\right\} O_3$; it belongs to the alcoholic series II, answering to the general formula $C_nH_{2n}O_3$, and the type $\left.\begin{matrix} C_n'''H_{2n-3} \\ H_3 \end{matrix}\right\} O_3$. This remark applies, *mutatis mutandis*, to other acids.

known as yet, which corresponds with the general formula $C_nH_{2n-16}O_7$.

The generic series of acids considered above may be ranged into one primitive series—

$$\begin{array}{l} C_nH_{2n}O_{2x} \\ C_nH_{2n-2}O_{2x} \\ C_nH_{2n-4}O_{2x} \\ C_nH_{2n-6}O_{2x} \\ C_nH_{2n-8}O_{2x} \\ C_nH_{2n-10}O_{2x} \end{array}$$

where O_2^x means, that in order to form a generic series from one of these primitive formulas, O has successively to receive suffixed the numbers 2, 3, 4, . . . x. It is easy to see that as every generic series, as for instance:

$C_nH_{2n-2}O_2$;	$C_2H_2O_2$,	$C_3H_4O_2$,	$C_4H_6O_2$ . . .
$C_nH_{2n-2}O_3$;	$C_2H_2O_3$,	$C_3H_4O_3$,	$C_4H_6O_3$ . . .
$C_nH_{2n-2}O_4$;	$C_2H_2O_4$,	$C_3H_4O_4$,	$C_4H_6O_4$ . . .
$C_nH_{2n-2}O_5$;	$C_2H_2O_5$,	$C_3H_4O_5$,	$C_4H_6O_5$ . . .
⋮			

consists of two kinds of series, of which those lying on the horizontal lines are homologous series, and those lying on the vertical lines are series of oxidation, the primitive series therefore expresses a seriation in a cube.

It is worth observing that there may be series of isomeric substances running parallel to each other; such series may be called homarithmical series.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. MULDER, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page* 139.)

I will even suppose, that when the last drop of nitrate of silver was added, a trace of precipitate made its appearance, but that experience has already taught us that one single drop more added would not have given any further trace of precipitate. Let us first get a nearer insight into this interesting matter; let us then try to explain it, and to answer the question which arises from this fact, and bears upon its technical application, viz.—how to determine exactly the precise quantity of chloride of sodium required to precipitate the quantity of silver originally present in a solution.

It follows from what has been just mentioned, that in the very liquid from which silver had been so precipitated, that the ultimate limit of a perceptible precipitate had been just reached, but nothing more; a decimal solution of silver will in its turn produce a precipitate in such a manner, that to 1002 milligrammes of silver at 15° to 17° C., it would appear as if one had used 0·54141 milligrammes of chloride of sodium too much; and this notwithstanding originally not a single drop of decimal salt solution had been added over and above that, necessary to complete the precipitation of chloride of silver.

The same liquid to which the decimal solution of silver has been just added, so that the utmost limit of precipitation had been reached, can now in its turn again yield a precipitate with the decimal solution of salt; for if this solution of salt be added we shall perceive that again about twenty drops of the solution, the temperature being from 15° to 17° C. will be required in order to reach the limit of another perceptible precipitate. If, on the other hand, we now again return to the decimal solution of silver, we shall see the repetition of the same phenomena. As long as the chloride of silver keeps white, it is possible to repeat the just-mentioned experiment, and, *vice versa*, we shall find that we can use either the silver or salt solution of identically the same strength in order to reach the limits of a perceptibly visible precipitate, provided also the temperature of the test liquid remains constantly as mentioned.

I have to observe, however, that the precipitate produced by silver is more slowly formed than that produced by salt. It will not be deemed superfluous to enter into more details. It must be observed, that in all the following experiments, unless the contrary be expressly stated, pure chloride of sodium was used for the standard and decimal solution, the standard solution being purposely rendered a little weaker in order to be more fit for use in observing and studying the phenomena to be described now and hereafter. When it is stated that one gramme of silver was weighed off, this is only mentioned in order to make known the quantity operated upon; for in the majority of cases such a solution of salt was used as would require 1003 parts, at a temperature of 15° C., to precipitate 1000 parts of pure silver. It would have been impossible to make the following researches unless I had been provided with such accurate and exact drop apparatus as would enable me to measure the decimal solutions of silver and salt, so that twenty drops of each exactly corresponded to one cubic centimètre. The decimal solutions of salt and silver were chemically an exact equivalent the one towards the other, one drop of the one having the same value as one drop of the other. This also is a chief requisite in order to distinguish what follows.

Pure silver was weighed off in the following quantities:

I. 1000 milligrammes.
II. 1002 ,,
III. 1004 ,,

and each quantity was dissolved in five cubic centimètres of nitric acid of a density of 1·20; it was afterwards precipitated at a temperature of from 15° to 17° C., first with the standard solution of salt, then with the decimal salt solution, until the limit of a perceptibly-visible precipitate had been reached; after this decimal solution of silver was again added, guttatim, two drops at a time, until the limit was reached; then again salt solution and then silver (always the decimal solution of both) solution again, in every instance until the limit was reached.

		Decimal Solution of Silver.			Decimal Solution of Salt.
A	I.	20	B	I.	20
	II.	20		II.	20
	III.	20		III.	20
C	I.	23	D	I.	20
	II.	23		II.	20
	III.	21		III.	20
E	I.	22	F	I.	22
	II.	22		II.	22
	III.	20		III.	22[1]

As the average of this experiment, we find that equally large quantities of the equally strong decimal solutions of silver and salt are required to produce a precipitate unto the limits of precipitability. We also find that this limit having been reached, there is a moment when, on applying

[1] The somewhat increased number of drops required when the experiment is continued for some time is due mainly to the heat the bottles receive while being shaken with the hands.

the last but one used precipitant, a new precipitate makes its appearance, which in both cases happens with 21 drops, equal to 1·05 cubic centimètres, or, if expressed in silver, equal to 1·05 milligramme weight thereof.

The experiment just mentioned has been often repeated with pure silver, and has always given similar results. We are, therefore, justified in stating, that, under the very same circumstances, that very liquid which apparently contains exactly enough salt, but no more, yields room for one milligramme of silver to precipitate salt (as chloride of silver of course); while, on the other hand, that liquid which apparently again contains just enough silver has room for 0·54 milligramme of chloride of sodium to precipitate silver.

The question, therefore, presents itself, what may be cause of this? As far as we are aware, the liquid only contains nitrate of soda and free nitric acid and chloride of silver in insoluble condition; nothing else. Chloride of silver may here be deemed as insoluble in water.[2] A solution of chloride of silver in water cannot be the cause in this instance.

Chloride of silver is soluble in solution of chloride of sodium; but not very much so at the ordinary temperature of the air. 1000 parts of chloride of sodium in concentrated watery solution only dissolve two parts of chloride of silver at 15° C. In case, even, therefore, the liquid in question might, after addition of chloride of sodium, contain a little free chloride of sodium, it would require 500 parts of chloride of sodium to dissolve one part of chloride of silver; but if, moreover, the chloride of sodium were the means of dissolving the chloride of silver, then, instead of a precipitate being generated about the end of the experiment,—a fact which visibly happens,—the formed precipitate ought to be seen disappearing, which is contrary to the effects observed in repeated experiments.

The solvent power of chloride of sodium here spoken of is, in fact, observed; but in order to be perceptible, a large excess of salt must be present, which is not the case in the experiment just alluded to.

Ten cubic centimètres of pure distilled water were mixed with one single drop of the decimal solution of silver, and also one single drop of the decimal solution of salt, a precipitate was formed, which was evidently stronger than a precipitate formed in 10 cubic centimètres of pure distilled water, to which had been added, first, one single drop of the decimal solution of silver, and then 20 drops of the standard solution of salt; in 20 drops of which are contained 5 milligrammes of salt, while one drop of the decimal solution of silver contains 0·05 milligrammes of silver. In this experiment the solvent effect of salt is already visible, but the excess of salt is also very large, for upon 5 parts of silver or 6·7AgCl, there are 500 parts of salt,—*i. e.*, 1 part of chloride of silver to 75 of salt.

The solubility of chloride of silver in common salt has, therefore, nothing to do with the phenomenon alluded to in the testing for silver. Chloride of silver, moreover, appears to be as much insoluble in dilute nitric acid as in water. To explain this phenomenon, there only remains to be seen whether chloride of silver is soluble in nitrate of soda: in fact, this solubility is the real cause of the mutual precipitation. I shall afterwards have often occasion to show the reality of this fact, but I now only mention the following simple experiment:—

In a bulk of 10 cubic centimètres of a solution of nitrate of soda of unknown degree of concentration, to which a small quantity of nitric acid had been added, 5 drops of a decimal solution of salt, and 5 drops of a decimal solution of silver, yielded a precipitate which on being heated was quite dissolved, whilst on cooling, the precipitate made its appearance again. Chloride of silver, therefore, is soluble in solution of nitrate of soda acidified with nitric acid and heat being applied. But it is not only so on application of heat: it is quite perceptibly so at the ordinary temperature of the room where the experiments take place.[3]

In order to ascertain whether the phenomenon of the mutual precipitation above alluded to is due to the formation of some double salt, or whether it belongs to the more simple phenomenon of solution, the following experiment was made at a temperature of from 15° to 17° C. Three grammes of pure silver were dissolved in 15 cubic centimètres of nitric acid, and partly precipitated with 300 cubic centimètres of standard solution, after which decimal solution of salt was added. The solution of the 3 grammes of silver was brought to the utmost limit of a perceptible precipitate, but no further. Decimal solution of silver was now added by drops, so as to give the utmost limit of precipitate; thereupon decimal solution of salt was added, and again silver, in every case just unto the utmost limit. The quantity required, therefore, expressed in drops, was the following:—

Silver, 60.
Salt, 60.
Silver, 60.

This experiment with 3 grammes of silver has thus required three times as much decimal solution of salt and silver as the experiment above alluded to. In the former experiment one gramme of silver was the starting point; in this experiment three grammes had been operated upon. Both experiments agree herein, that in either of them a large excess of chloride of silver insoluble in the liquid, is present. The phenomenon in question is, therefore, intimately connected with the quantity of the liquid. This liquid is water, containing nitrate of soda, with a small quantity of nitric acid. In the one instance there are rather more than 100 cubic centimètres; in the other case somewhat above 300 cubic centimètres. There is, therefore, every reason to assume that in order to explain the phenomenon of the doubly mutual precipitation the main cause of this phenomenon is solution, as defined by Berthollet.

It is now time to call attention to another peculiarity. We know already that one gramme of silver precipitated by common salt (standard solution) at a temperature of 15° to 17° C. easily bears 20 drops of decimal solution of silver, and again 20 drops of decimal solution of salt. What will be the condition if only 10 drops of the decimal salt solution are added after the silver solution? And if we refer to the experiment just described, in which three grammes of silver were used, what will happen if after the precipitation with salt to the very limit, instead of 60 drops of decimal silver solution only 30 are added?

Guy Lussac has already alluded to this, although only briefly, for in his "Instruction" he says (page 19):—"Il est a remarquer que, lorsque la dissolution normale

[2] It is not absolutely so, as has been discussed in this treatise already.

[3] I have to observe that when to the last-mentioned liquid had been added 15 drops of the decimal solution of salt, and heat was applied, the precipitate thereby quite disappeared, but reappeared again after cooling. Nitrate of soda and chloride of sodium have, therefore, the property of dissolving chloride of silver with aid of heat.—M.

est parfaitement au titre, elle louchit très légèrement, soit avec le nitrate d'argent, soit avec le sel marin."

Suppose that 10 drops of the decimal silver solution are added to the liquid obtained by dissolving one gramme of silver (temperature 15° to 17° C.) which has been first precipitated with standard solution, and which has been afterwards brought by decimal solution of salt to the very limit; that after the addition of the 10 drops of decimal silver solution, the liquid has been well shaken, and after the precipitate has settled, the clear supernatant liquid be poured off and divided in two test glasses; on addition to the one part of these liquids of nitrate of silver, and to the other chloride of sodium, both in decimal solution, precipitates will be seen making their appearance, which, if the experiment was well executed, will amount to the same quantity in each of the liquids operated upon. I added 30 drops of decimal solution of silver (temperature 15° to 17° C.) to the liquid in which the 3 grammes had been dissolved. After having well shaken the liquid, and after the precipitate had settled, the clear liquid was poured off in two glasses. Five drops of decimal solution of salt having been added to the one, and 5 drops of decimal solution of silver to the other, gave rise in both cases to perfectly similar precipitates.

(To be continued.)

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page* 182.)

The Means of Weighing.—Four balances and two sets of weights have served for all my weighings. One of the balances, constructed by the celebrated French mechanician Gambey, carries one kilogramme in each pan, and turns when loaded with this weight to five-tenths of a milligramme. The other three were made by M. Sacré, mechanician to the Museum of Industry at Brussels. The largest of the three, which was constructed expressly for my researches, will bear a weight of five or six kilogrammes in each scale, and marks with certainty under this enormous load a difference of weight of one milligramme. Laden with two or three kilogrammes in each scale, it turns quite perceptibly with a variation of three or four-tenths of a milligramme. The second balance carries five hundred grammes in each scale, and denotes a difference of two-tenths of a milligramme. Lastly, the third, which is an assaying balance, turns definitely when loaded with twenty-five grammes in each side to a thirty-third of a milligramme. I do not believe that there exists another set of balances which for sensibility and accuracy are to be compared with these I have mentioned. Every chemist who has had occasion to examine them has come to the same conclusion; therefore I do not hesitate to say that they do honour to M. Sacré, and I may add that I feel much pleasure in being able to pay this tribute to his ability. The two sets of weights which I used are one of platinum, the other brass. The platinum set contains the kilogramme and all its subdivisions to half-a-milligramme. It was made by M. Gambey, under the superintendence of M. Arago. It constitutes the standard of the second order of the State of Belgium. I had occasion to verify its perfect conformity with the platinum standard preserved in the Chamber of Representatives, likewise made by M. Gambey, and compared by M. Arago with the standard kilogramme deposited with the archives of the State in Paris. The other set of weights was adjusted by myself with every possible care by means of the platinum standard. The subdivisions of the milligramme down to tenths of these weights are made out of flat silver thread.

Finally, so as to be able to reduce all my weighings to a vacuum, I have determined the specific gravity of platinum and brass. I thus found that the platinum kilogramme displaces 47 cubic centimètres of air, and the brass 125 cubic centimètres. All my calculations have been made from these two data, whether I have performed the weighings in the air and have applied the corrections to both the weights and the material, or whether I have weighed in a vacuum and have submitted to correction the weights alone.

The Weighings.—Whenever the nature of the substance did not offer an insuperable obstacle, I have performed the weighings in air, and have placed as a counter-weight to the vessel containing the substance another vessel of the same nature and size, and, as near as possible, of the same weight as the one which it is intended to counterbalance, the difference between the weights being made up by a further addition of the same material. I have only resorted to weighing *in vacuo* as a means of control or when employing matters which were hygroscopic or liable to absorb air. I have effected the weighings *in vacuo* differently according to the shape of the vessels containing the substances, and according to the nature of the products which were to be formed. When the operation was performed in glass tubes, those containing the materials were introduced in a glass cylinder furnished with a metallic connection and a stop-cock, by which a vacuum could be obtained. To counterbalance this cylinder I employed another, absolutely identical as to its exterior volume, its shape, and matter of which it was composed; besides which, I took all the precautions at first suggested by M. Dumas for effecting in safety a weighing *in vacuo* and always obtaining constant results. When the shape of the vessels would not admit of this mode of operating, I fastened either a metallic connection, by means of a resinous cement, to the mouth of the vessel, or a cap of unvulcanised india-rubber furnished with a stop-cock. In this latter case I took care to use as a means of fastening thick pieces of platinum, silver, or copper wire slightly flattened; and to obviate the action of the air upon the caoutchouc—for in the air caoutchouc absorbs oxygen and increases in weight—I wound the metallic wire round in such close spirals that the surface was entirely covered. An arrangement of this kind perfectly preserves a vacuum, especially if care has been taken to roughen that portion of the glass to which the caoutchouc is applied.

This was equipoised by an apparatus absolutely identical in external volume and extent of surface. This arrangement, suspended in a large frame beneath the balance, hung freely in the air which was kept as dry as possible, and guarded by means of thick wooden partitions from all movements either from currents or heat. MM. Dumas and Regnault have already shown that on weighing with these precautions the equilibrium, once obtained, is preserved indefinitely. Whenever my apparatus has preserved a vacuum perfectly (which is much more difficult to effect than would be supposed) I have been enabled to verify the accuracy of this statement.

In all my weighings *in vacuo* the internal tension was, both before and after the experiment, between ·0025^m to 0·003^m; the air-pump would not permit me to go beyond that.

I have already stated above that, unless it was absolutely necessary, I performed the weighings in air; for I have shown in the most certain manner that vessels full of air always have a uniform weight as soon as the surfaces of all those portions of the apparatus which are in equilibrium are under the same conditions. When these conditions are changed, either by a slight elevation or depression of temperature, it takes a long time to bring them to their original state. Thus a tube of hard glass 60 to 80 centimètres long and 2 to 2·5 in diameter, after having been strongly heated, requires to be kept for two or three hours in the balance case before its weight becomes constant. Glass flasks of 1 to 4 litres capacity, after having been heated or rubbed, do not attain a constant weight until they have remained in the balance case for five or six hours.

Polished platinum heated out of contact with flame rapidly regains its primitive weight. But when this metal is more or less roughened it attains its proper weight much more slowly than either glass or porcelain.

The Vessels Employed in the Determination.—I have had recourse to platinum vessels whenever the nature of the operations permitted it. Otherwise I have only used for my determinations vessels and tubes of Bohemian glass. Berzelius has frequently cast doubts upon the inalterability of the vessels employed in analysis. According to my experience this doubt is well founded. I have, in fact, found that the weight of tubes, retorts and flasks, even of hard Bohemian glass, is changed very appreciably either by the action of flame or of chemical agents which are ordinarily considered to be without action on them. Without any exception whatever, all glass, when long heated to redness in a spirit or gas flame, slowly but constantly diminishes in weight.

This loss may reach 35 or even 40 milligrammes in the space of two hours when a tube of Bohemian glass 50 or 60 centimètres long is exposed to a decided red heat in a gas flame. The same glass preserves, on the contrary, a constant weight when it is heated to the point of softening and bending under its own weight, away from the flame, either by means of charcoal—taking care to keep the ashes from touching the tube—or in a bath of pure magnesia which completely surrounds it. It will be seen further on, when analysing chlorate of potash, that I have heated, for an entire day, tubes and flasks of Bohemian glass even to the point of rendering them milky and white without in the least altering their weight. The magnesia bath has rendered me great services. In it I have heated to redness not only glass but also the platinum vessels in which my determinations have been made. A wash with water acidulated with hydrochloric acid completely removes the traces of magnesia always adhering to glass or platinum which has been heated in contact with it. Were it not for this bath, I should have had to give up, in a great many cases, the employment of gas as a source of heat. As far as I know, MM. Erdmann and Marchand were the first to employ magnesia for keeping surfaces away from the contact of flame.

I have sufficiently proved that at temperatures below 300° or 350° C. neither nitric nor hydrochloric acids exert any action upon Bohemian glass, nor in general upon any hard glass perfectly free from alumina and excess of alkali.

Flasks of Bohemian glass, after having been used for a considerable number of syntheses of nitrate of silver, nitrate of lead, and chloride of lead, have preserved their original weight almost absolutely. The very slight alteration which they may have experienced proceeds rather from the friction of the stopper, which is ground into the neck with emery, rather than to the action of acids.

Retorts, globes, and flasks of common glass, yield even at the ordinary temperature, traces of their basic constituents to hydrochloric and nitric acids.

Experience has shown that sulphuric and hydrochloric acids, as well as the vapour of sal-ammoniac, attack all kinds of glass at a red heat.

The Agents Employed in the Determinations.—It was not only necessary for me to have vessels capable of withstanding the action of the agents used therein, it was also needful that these agents should not bring with them ingredients capable of altering, either as to weight or composition, the bodies of which it was desired to determine either the formation or decomposition.

The intermediate bodies employed in my experiments have been water, hydrochloric, nitric and sulphuric acids, and sal-ammoniac. I confess that previous to undertaking this long work I had been completely mistaken as to several of the difficulties which had to be overcome before I could procure these bodies in a state of purity. Berzelius in his work on the atomic weights[1] has already mentioned the difficulty of obtaining liquid hydrochloric acid which would not leave a residue upon evaporation, and even confessed that he could not himself arrive at this result.

I, therefore, give here the experiments which I have made, both the methods which I have devised to procure these bodies in a pure state, and the means employed to ascertain this purity.

Water.—Either rain or spring water, twice distilled, taking care the second time to condense the steam in a platinum refrigerator, yields a liquid which, when evaporated immediately afterwards in a platinum vessel, either covered or freely exposed to the air, volatilises without leaving the slightest residue. This same distilled water, after having been kept for some days in a platinum or porcelain vessel, and then evaporated, leaves a very appreciable brownish-yellow residue, which burns away completely at a red heat in the air. Distilled water, which would volatilise completely in a covered or open vessel, if acidulated with pure hydrochloric or nitric acid, then leaves, when evaporated in a covered or open vessel, a yellow residue.

Distilled water contains, therefore, volatile organic matter, which, after a certain time, becomes spontaneously fixed, and becomes instantly so under the influence of nitric or hydrochloric acids.

When the presence of organic matter, fixed, but capable of destruction by heat, offered no objection, I made use of water twice distilled, and condensed the second time in a long platinum tube properly cooled. In the other case, at the first distillation, I slowly passed the vapour through a long copper tube, luted with clay and sand, completely filled with oxidised copper turnings, bent in a zigzag manner, and heated to a decided red heat in a furnace. The water resulting from the condensation of this vapour was re-distilled a second time and condensed in a platinum refrigerator. This refrigerator is a long platinum tube, soldered with gold, bent into the form of a syphon, and employed in a manufactory to conduct and cool the vapour of boiling concentrated sulphuric acid. This water, either immediately after its preparation or after being kept a long time in a stoppered flask, if submitted to evaporation by itself, or

[1] *Ann. de Phys. et de Ch.*, t. xi., p. 65.

acidulated with nitric acid, always volatilises in a covered vessel without leaving any trace of residue.

Hydrochloric Acid.—The liquid hydrochloric acid which I have made use of was obtained by conducting hydrochloric acid gas, by means of a Bohemian glass tube, into water deprived of all matter, fixed or capable of becoming so, and contained in a platinum tube. The hydrochloric acid gas was disengaged by the action of heat upon the pure liquid acid, such as is met with in the laboratory.

The acid thus obtained can be evaporated to dryness in a platinum retort without leaving the least trace of residue. If the evaporation is effected in an open vessel, the matters floating about in the air are always fixed by the acid, and then the purest product will leave a yellow residue, in which iron is often found. The testing of hydrochloric acid should, therefore, be done out of contact of air, contrary to the plan usually adopted.

Nitric Acid.—To procure absolutely pure nitric acid, I heated the commercial acid, sp. gr. 1·500, until the condensed product contained no chlorine.[2] The nitric acid thus obtained was twice re-distilled, and preserved in flasks. When I desired an acid leaving absolutely no residue, I re-distilled the purified acid a third time in a large platinum retort, employing a globe of Bohemian glass as a receiver. The acid was always used immediately after its preparation. I test its purity by operating on a whole litre. It evaporates in a platinum retort without leaving the slightest residue, when its vapour is carefully guarded from contact with the air.[3] If the air has free access to it, the acid always leaves a more or less appreciable yellow residue, exactly as we have seen in the case of pure hydrochloric acid and pure water acidulated with acids, when evaporated without guarding them from atmospheric impurities. According to my experience, I am led to believe that the impurities found by most chemists in acids do not always pre-exist there, but have been communicated to them by the air having free access to them during the assay. *For this reason I have been obliged to perform my assays in platinum retorts fitted tightly to a Bohemian glass receiver; and all the evaporations of acid liquids have been performed in close vessels so as to prevent the air from penetrating into the interior of the vessels containing the liquid undergoing evaporation.*

Sulphuric Acid.—To obtain this quite free from all fixed principles, I distilled the commercial acid in a luted glass retort. The acid so prepared was re-distilled by small portions at a time in a platinum retort, taking the precaution to volatilise the liquid without allowing it to boil. As a condenser I used tubes of platinum soldered together with gold, the ends being ground so as to fit tightly one within the other. The acid was collected and preserved in a platinum crucible until required for use. It never left a trace of residue when evaporated in a platinum retort.

Sal-ammoniac.—I will detail subsequently all the precautions which I have taken to obtain sal-ammoniac absolutely pure.

Carbonate of Soda.—Carbonate of soda, deprived of alkaline chlorides and sulphates by successive crystallisation, always contains iron. To remove this metal the salt was dried and heated to dull redness in a silver dish. After cooling, the anhydrous carbonate was added to a quantity of cold water insufficient to dissolve it. The solution was evaporated in a silver dish, and the residue dried and calcined a second time. This treatment was repeated until hydro-sulphuric acid no longer coloured the solution of the carbonate green. I have been obliged to repeat three times the successive action of heat and water to obtain this result. Carbonate of soda so purified still contains silica.

(To be continued.)

[2] The assay of fuming nitric acid for chlorine requires that it should be previously mixed with four or five times its volume of water. Indeed, an acid at its maximum of concentration can contain traces of chlorine without being rendered turbid by nitrate of silver solution. This is easily seen by adding nitrate of silver to pure water and then mixing a few drops of this solution with nitric acid, which contains traces of chlorine. The acid will remain clear, but by adding to it the remainder of the water, the liquid will be seen to be decidedly turbid.

[3] Platinum vessels are not suitable for the preparation of pure acids until they have been freed from the iron which ordinary manufactured platinum always contains. The best way which I have found for arriving at this result is to cause the vapour of dry chloride of ammonium to react upon them at a red heat. As long as the chloride of ammonium is slightly coloured yellow, it is certain that the metal contains iron. The platinum in this manner becomes dull-looking and much whiter. Before weighing the vessels so purified, they must be polished. It suffices for that to put them in a lathe and burnish them by means of an opal. All my platinum vessels have been treated in this manner.

Experiments on the Best Mode of Correctly Estimating the Per-centage of Alcohol Existing in Wines, by JOHN HORSLEY, *F.C.S. Lond., Analyst to the County of Gloucester.*

FIRST note the specific gravity of the wine to be tried, say that compared with distilled water at 1000 it is ·997, or 3 short of that number; then take 5 fluid ounces of the wine and evaporate it by rapid boiling in a sufficiently capacious flask to 2 ounces; then place the flask in a pan of water for a short time to cool. By this operation you will have expelled not only all the spirit, but a good portion of water with it.

Next make this residuary liquor containing the sugar and other extractive matter of the wine, minus its alcohol, up to the original bulk with distilled water, and take its specific gravity, which in this case will be 1·020. If this excess of 20 over the weight of the standard of distilled water be deducted from the specific gravity of the wine thus,—

·997 including its spirit, water, and other extractive matter of the grape;
20 amount of extractive matter in the water only;

·977 will be the true specific gravity of the spirit and water contained in the wine, minus the extractive matter, which is equal to 17 per cent. of alcohol, according to the published tables of alcoholic strengths at different densities and temperatures. Or, which is nearly the same thing, we may proceed by subtracting the specific gravity of the wine, ·997, from the residuary liquor, thus 1·020

997

leaving ·23, which, deducted from the standard of distilled water 1000

23

leaves ·977 as the true specific gravity of the spirit and water in the wine.

These examples may be further verified by a distillatory experiment thus:—Take 5 ounces of the wine; distil off exactly half by a gentle heat from a graduated retort to which a receiver is connected till oiliness ceases to form in the tube end of the retort, indicating that all the alcohol has passed over. The specific gravity of this distillate (consisting of spirit and water) will be

·955, equal to 34 per cent., which, divided by 2,—as only half the bulk has been drawn over, gives 17 per cent. Or the distillate may be diluted with its own bulk of distilled water up to the original 5 ounces, when its specific gravity will be ·977, equal to 17 per cent. of alcohol.

This per-centage may be converted into Revenue proof spirit by rule of three sum, thus:—

Alc. Wat. Alc.
As 49 : 51 : : 17 = 17·69 water
17 alcohol

Proof . . 34·69

TECHNICAL CHEMISTRY.

On the Artificial Colouring Matters derived from Aniline, by M. E. KOPP.[1]

IN the abstracts of the papers by M. Kopp, which we published in vol. ii. of the CHEMICAL NEWS, a general history was given of the production of aniline, and the various processes adopted for obtaining the coloured derivatives of that body. M. Kopp now passes in review several Memoirs that have been published in France on the Chemistry of the Colouring Matters. This, he remarks, is still extremely obscure; and none the less so that in these Memoirs there are not only wide disagreements in the theoretical views entertained, but differences as to simple facts, and difficulties and contradictions to be met with in the writings of the same author. We shall give a short summary of these papers, at the risk of repeating once or twice what has already been published in the CHEMICAL NEWS.

The first paper noticed is M. Guignet's "Researches on Fuchsine." This substance is obtained in the form of a viscous mass, which in time becomes almost completely solid. It gives a bright red solution with alcohol, both absolute and somewhat diluted; it is also slightly soluble in ether and sulphide of carbon. It is soluble in boiling water, but on cooling it is deposited in reddish-brown scales, which do not appear to have a definite crystalline form. Nitric acid dissolves it, forming a yellow solution, which, on being diluted with water, becomes red. It gives a precipitate of chloride of silver with the nitrate, showing that the solution contains a hydrochlorate. (M. Guignet regards fuchsine as a mixture of a peculiar base with its hydrochlorate.) The nitric solution evaporated at a low heat yields well-formed prismatic crystals, of a deep brown colour. Water and alcohol partially decompose these crystals, giving a red solution; but a part of the salt crystallises again without having undergone any change.

Strong sulphuric acid decomposes fuchsine, disengaging an abundance of hydrochloric acid vapour. It forms a yellow solution, which, on cooling, b comes a mass of yellow plates, like mica. These plates appear to be an acid salt. When the solution is carefully saturated with carbonate of baryta, another sulphate is obtained, which crystallises in colourless needles. Lastly, hydrochloric acid dissolves fuchsine, forming a yellow solution, which yields brown prismatic crystals. All the above solutions are precipitated when they are exactly saturated with ammonia. Carmine-red flocculi are deposited, which are slightly soluble in water, and freely soluble in alcohol. In contact with an excess of ammonia or caustic potash these flocculi are completely decolorised and changed into a white insoluble matter, which, however, re-assumes its red colour when treated with water or acids. The same is observed with stuffs dyed with fuchsine. The colour is discharged by caustic potash, but re-appears when the tissue is washed with water or treated with an acid.

M. Guignet expresses an opinion that fuchsine may have the composition $C_{12}H_7ClN_2$, and be analogous to nitrazophenylamine, $C_{12}H_7(NO_4)N_2$. This opinion, however, is not shared by M. Kopp, who observes, that the fuchsine of MM. Rénard and Franc is a very complex substance; and it is possible that many of the reactions described by M. Guignet, and some of the crystallised bodies he has observed, are derived, not from the colouring matter itself, but from the bodies which accompany it. The experiments should be repeated with fuchsine purified by the process of M. Schneider—which we shall presently describe—or with the colouring matter obtained from wool or silk previously dyed.

The ideas of M. Bechamp on the formation of fuchsine next quoted by M. Kopp, we have already given at p. 311, vol. i., and p. 215, vol. ii. We need not, therefore, repeat them here. The properties of fuchsine he describes as follows:—It is an organic base, slightly soluble in water, having the formula $C_{24}H_{10}N_2O_2$. In the hydrated state it is of a deep red colour. When pure, as it is obtained by precipitating the alcoholic solution with ether, it appears in form of non-crystalline scales of a brilliant metallic green colour. The aqueous and alcoholic solutions, and the solutions in wood spirit and acetone are red. It forms uncrystallizable salts, the solutions of which are red when they are neutral, and yellow with an excess of acid. Sulphurous acid slowly decolorises the solution, but by concentration at a gentle heat the colour is restored. With hydrochloric acid it forms two kinds of salts—neutral and acid—the former ($HCl + C_{24}H_{10}N_2O_2$) is red, and gives a red solution; the second ($2HCl + C_{24}H_{10}N_2O_2$), obtained by passing hydrochloric acid gas over the hydrated fuchsine dried in a vacuum, is of a cinnamon brown colour, and gives a reddish-brown solution. Experiment gave 17·3 and 15·25 per cent. of acid in the neutral salt; calculation requires 15·6 per cent. The same salt gives a purple precipitate with chloride of platinum, which dissolves in alcohol, giving a violet red solution. The formula of the precipitated salt is $PtCl_2 + C_{24}H_{10}N_2O_2HCl$. This formula requires 24·26 per cent of platinum. Experiments gave 24·43 and 24·56 per cent. of platinum.

Bechamp's views of the formation and constitution of fuchsine have been combatted by Barreswil, who has shown that fuchsine is a non-oxygenated body. In fact, by operating with perfectly anhydrous bichloride of tin and aniline under circumstances in which it was impossible for air or moisture to reach the materials, he made fuchsine. The formula of M. Bechamp, therefore, cannot be exact. It is, moreover, contradicted by the fact that fuchsine is generated when aniline is treated with iodine, bromine, sesquichloride of carbon, and iodoform, neither of which contains oxygen nor reducible bases.

MM. Persoz, de Luynes et Salvétat, in their report on aniline red, have pointed out a number of facts. They first verified the production of the red colouring matter by heating an hydrous bichloride of tin with aniline, and also with the hydrated bich oride, protosulphate of tin, iodoform, iodine, mercurous, uranic, and ferric nitrates, and the fluoride of tin. When operating with 8 kilogrammes of aniline and 4½ kilogrammes of anhydrous bichloride of tin, they obtained in twenty minutes

[1] Abridged from the *Moniteur Scientifique*.

a pasty mass of a bright red colour. By boiling together for one hour 4·2 kilogrammes of aniline and 2·3 kilogrammes of mercurous nitrate, they obtained a syrupy substance of a violet-red colour. They also made the colouring matter by means of arsenic acid, and proved that in this operation the arsenic was not reduced to arsenious acid, and yet that nearly the whole of the aniline was transformed.

Their ideas on the formation of fuchsine are the following:—It is not a product of the oxidation of aniline, but the result of a molecular change in that body, occasioned by the presence of various chemical agents. To effect this molecular change, it is necessary to employ a temperature of from 180° to 200° C. Indisine, or the violet colouring matter, on the contrary, is an oxidised product, the formation of which is always accompanied by the production of a good deal of resinous matter. From this it results that when non-oxidisers are employed, only fuchsine is formed, while oxidising bodies induce the formation of indisine, but in relatively small proportions, under even the most favourable circumstances.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 1, 1861.

E. W. Binney, *F.R.S., F.G.S., Vice-President, in the Chair.*

A letter from Dr. Fairbairn, F.R.S., &c., tendering his resignation of office as one of the Vice-Presidents of the Society having been read, it was moved by Mr. Spence, seconded by Mr. J. A. Ransome, and unanimously resolved, "That the Members of the Literary and Philosophical Society express their regret that Dr. Fairbairn feels it necessary to resign his Vice-Presidentship of the Society, and hope he will still continue to favour them with his presence and his valuable contributions as formerly."

Dr. Schunck, F.R.S., &c., was elected a Vice-President, in place of Dr. Fairbairn, F.R.S.

Mr. Alfred Fryer was elected a Member of the Council in place of Dr. Schunck, F.R.S.

Dr. Schunck announced to the meeting that Messrs. Spence; Roberts, Dale, and Co.; Tennants and Co., and others had, at his request, presented to the Society a portion of the beautiful products which had formed part of the interesting exhibition in the laboratory of Owen's College during the late meeting of the British Association.

It was moved by Dr. Schunck, seconded by Dr. Clay, and unanimously resolved, "That the thanks of the Society be given to the donors of chemical products."

Mr. Baxendell, F.R.A.S., read a Paper entitled "*Observations of Comet* 1, 1861."

Although this comet was not at any time a very conspicuous object to the naked eye, yet some of the features which it presented when viewed with a good telescope at the time of its greatest brightness were sufficiently remarkable to render it an object of peculiar interest to the astronomer; and I have therefore thought that a brief account of the observations made with the excellent instruments of Mr. Worthington's observatory might be acceptable to the members of this Society.

My first observation was made on the night of May 3, 1861. The comet was then already visible to the naked eye as a dull hazy-looking star of the 4½ magnitude. At 10h. 17m. 48·7s. G.M.T. a comparison with the star *Arg.* 178,8=190,112 made with the equatorially-mounted achromatic of 5 inches aperture, and a dark field photographed micrometer constructed by Mr. Dancer, gave the comet's apparent place R.A. 10h. 5m. 27·76 Dec. + 48°52′ 7·7″. Turning the 13-inch reflector upon the comet with powers of 81 and 196, it was found that the nebulosity was more than 20′ in diameter, considerably condensed in the middle, but without any distinct planetary or stellar nucleus. There was a faint tapering elongation extending about a quarter of a degree from the north following side, and stars of the 11th and 12th magnitude were easily seen through the comet at the distance of half a radius from its centre.

May 4.—Three comparisons with *Arg.* 173,122 gave the place of the comet at 9h. 26m. 19·3s. G.M.T. R.A. 9h. 52m. 19·83s. Dec. + 45° 18′ 28·1″.

With the 13-inch reflector the diameter of the nebulosity constituting the head of the comet, carefully estimated by comparison with the known diameter of the field of view, was 22′. It was much condensed in the middle, but there was certainly no distinct stellar nucleus. The centre of greatest condensation was not in the centre of the nebulosity, but towards the *north following side*. The tapering elongation of last night was now a narrow and slightly fan-shaped tail of 2¼ degrees in length, but apparently separated from the nebulosity of the head by a remarkable and comparatively dark interval. The point of origin of this singular tail was estimated to be from 12 to 15 minutes distant from the centre of the head, and its breadth at this part was about 4½ minutes, and at its extremity about 15 minutes. Its axis was perfectly straight, and its brightness was greatest at the narrow end, where it was equal to that of the nebulosity of the head at two-thirds of the radius from the centre.

May 5.—At 10h. 16m. 59·7s. G.M.T., six comparisons with *Lalande's* 19168 gave the comet's apparent place R.A. 9h. 39m. 37·82s. Dec. + 41° 21′ 34·5″.

The sky to-night was not very favourable for the observation of faint objects, but the general features of the comet did not appear to have undergone any material change. Last night it occurred to me after leaving the observatory that the axis of the tail was not exactly in the direction of the comet's radius vector, and to-night I found its angle of position at 13h. 35m. sidereal time to be 96·7°. At this time the position of the sun and comet were:—

The sun	R.A. 42° 54′	N.P.D. 73° 33′.
The comet	R.A. 144° 50′	N.P.D. 48° 43′.

From these data we find that the angle of position of a prolongation of the comet's radius vector, was 69·9°. The apparent deviation of the axis of the tail was therefore 26·8° in the direction of the comet's motion.

May 7.—At 12h. G.M.T. the comet appeared to the naked eye to be nearly equal to μ Leonis, and equal to, if not brighter than, 38 Lyncis.

May 9.—Three comparisons with *Lal.* 17,987 gave the comet's apparent position at 9h. 57m. 30·5s., R.A. 9h. 3m. 23·25s. Dec. + 26° 11′ 26·1″.

At 13h. 15m. sid. time the angle of position of the axis of the tail was 103·2°. At this time the angle of position of the comet's radius vector was 74·5°; the deviation therefore amounted to 28·7°.

With the 5-inch achromatic the tail appeared to be half a degree in length; but with the 13-inch reflector it was fully one degree, though fainter than when last observed, and still much less in breadth than the diameter of the head. The average diameter of the head was about 20′, but the nebulosity extended farther on the south preceding side of the point of greatest condensation than on the north preceding or north following sides. There was still an entire absence of any stellar nucleus. To the naked eye the comet appeared as a star about equal in brightness to μ Leonis.

May 14.—Notwithstanding the moonlight, the comet was

still visible to the naked eye, and in the 5-inch achromatic with a power of 68 it was about 10′ in diameter. The tail, however, could not now be seen.

May 17, 10h. 25m. The comet, though at a very low altitude and with strong moonlight, was still very easily seen with the 5-inch achromatic, and did not appear to have diminished since the 14th inst. This was the last opportunity I had of observing it.

Lalande's stars Nos. 19168 and 17987 occur in Bessel's Zones Nos. 454 and 347, and Bessel's places have been used in making the reductions.

Some remarks having been made by Mr. ATKINSON and Mr. VERNON respecting the vibrations of the barometric column which frequently take place during gales of wind,

Mr. FRYER stated that, with a view of ascertaining whether the barometer was subject to minute oscillations inappreciable by the ordinary method of observing, he had placed an aneroid barometer under the microscope, using the quarter-inch object glass, and by bringing one of the striæ on the surface of the steel index into focus, he was able, by means of the micrometer, to observe a movement of the 20,000th of an inch. The index appeared to be in constant motion, but at present he was not prepared to lay any set of observations before the Society. Mr. Fryer also suggested, for the same purpose, the use of a barometer filled with the oleine of olive oil, such an instrument being free from the disturbances caused by the watery vapour present in the water barometer and exhibiting a greater range.

PHYSICAL AND MATHEMATICAL SECTION.

April 25, 1861.

Mr. MOSLEY read an extract from a letter received by him from Dr. Martin, of Lisbon, in which were enclosed a series of meteorological observations taken at that place, from the 6th to the 12th February last, both inclusive.

Mr. VERNON produced a printed series of meterological observations made at Sydney and Paramatta, in 1857, 1858, and 1859 which he presented to the Section.

Mr. BAXENDELL gave details of observations which he had made during the last few days on a large and remarkable solar spot, in which the secondary penumbra had been plainly visible, and had been observed by him to consist of a fine net work of bright lines. The penumbra was strikingly striated, and the middle of the nucleus had been occupied by a bright spot detached from the penumbra at first, but afterwards joined to it, as the spot began to close up, by one of the projecting spurs usually observed to occur in decaying spots. For the purpose of the observations a trough filled with sulphate of indigo was placed in the cone of rays coming from the large mirror of a Newtonian reflector of seven inches aperture, before they reached the eyepiece. The sun's image was a deep red colour, but the definition was very good.

Professor CLIFTON suggested that the unusual visibility of the secondary penumbra in this case might arise from its being so coloured as to be rendered more visible than usual by the use of the sulphate of indigo.

July 27, 1861.

Mr. BAXENDELL read a Paper entitled "*Observations of Comet I*, 1861." [This Paper was afterwards read at the Ordinary Meeting of the Society, held on October 1, 1861,]

Mr. BAXENDELL also read a note "*On a Solar Spot of Long Duration.*"

At the last Meeting I exhibited a sketch made on April 24, 1861, of a solar spot in which the secondary penumbra had been seen with unusual distinctness. This spot has since twice crossed the visible disc of the sun, and has had a term of existence considerably above the ordinary average. It was first seen on April 17, near the eastern limb of the sun, and was then a fine spot of not less than the third magnitude, and after undergoing many considerable changes of form and structure, was finally observed very near the western limb on June 21, as a spot of only the 9th or 9½ magnitude, and from its previous rate of decrease it is probable that it would become entirely extinct in four or five days afterwards. Its duration, therefore, would not be less than 70 days, and it thus affords a striking instance of the fact that frequent and extensive changes of form and structure do not necessarily tend to produce an early extinction of a spot. Between April 20, at 5h. 13m. G.M.T., and June 15, at 5h. 30m. it moved through 783·3 degrees of longitude, or at the rate of one sidereal revolution in 25·74 days. On April 20 its heliographical latitude was 14° 11′ N., and on June 15 14° 2′ N. These results indicate a direction and rate of drift which agree very nearly with the results which Mr. Carrington has obtained for other spots in and near the same parallel of latitude.

NOTICES OF BOOKS.

A Manual of Qualitative Analysis. By R. GALLOWAY, F.C.S. Professor of Practical Chemistry in the Museum of Irish Industry. Third Edition. London: John Churchill, 1861.

IN the preface to the second edition of Mr. Galloway's Manual, the author describes in some detail the method of teaching Chemical Analysis which he has found to answer best. The comparatively rapid sale of his work, and the appearance of a new and improved issue, at the present time, when so many other volumes on the same subject have been published, seem to demand a careful notice of the points in which Mr. Galloway's plan differs from other plans. We propose therefore to criticise the account which the author gives of his own scheme of analysis, and the way in which he wishes it to be used (pp. vi., vii., viii.)

He says:—"In all other works on Chemical Analysis with which I am acquainted, the properties of the bases and acids, and the application of these properties to the analysis of substances, are treated separately. As a consequence, the student, when he goes through the experiments on each base and acid, performs these illustrations of the properties, without perceiving their use or application." This objection is easily obviated, if those properties of each base and acid which are actually made use of in analysis be distinguished from the others by a different type, at the same time that all the compounds mentioned under one acid or base are mentioned under all others, even if they are soluble. This plan has not yet been adopted in more than one Analytical Treatise, so far as we know.

Mr. Galloway proceeds:—"In the part of the work devoted to the Analytical Course, he is told what to do, either by tables (as in 'Giessen Outlines,' and some other works,) or, as in Fresenius, by a more tedious, and, in my opinion, as defective a method. The principles upon which these instructions are based, are not given with the instructions, but in a separate chapter of the work; and, unless the student is able himself to unite the two,—the principles which the practical instruction,—he becomes a mere analytical machine." Here we think that our author depreciates too much the methods of other teachers of the analytical art.

The student is generally first taught the chief features of the bases and acids, the most characteristic compounds of each base and acid having been specially pointed out to him. This done, and a broad view of the whole subject having been acquired, he proceeds to utilise his knowledge by the application of particular facts in the actual course of analysis. He has already learnt the distinction between group and special tests, and will find no difficulty in seeing why such and such re-agents are used in different cases.

We concur in Mr. Galloway's opinion of the plan adopted by Fresenius. There can be no doubt about its being tedious and difficult. The objection to tabular statements of analytical plans entertained by the great German analyst, seems almost morbid. Whether they appear as tables or not, analytical operations can only be represented in tabular statements. Those given by Fresenius are merely spread over some two or three pages, somewhat vaguely, instead of being concentrated in a systematic and intelligible form on one page only. Fresenius' plan is less costly to print, but, at the same time, more difficult to understand. One can scarcely work through a few pages of his "System of Instruction in Qualitative Analysis" without meeting with such delightfully complicated directions as this,—"Test for cobalt and nickel, as directed, § 192, 1, b, β, ββ, (149)."

Mr. Galloway characterises the ordinary system as difficult as well as defective; he says, "It is so difficult, that those who employ it generally teach one thing, useless in itself, in order that they may teach another; they teach the student first to look for one acid and one base —a limitation which is not adopted in actual practice—solely for the purpose of rendering the course in which they have [? he has] to look for all the bases and acids less difficult." We do not think it quite useless for the student to be able to detect one acid and one base; the principle of progressive exercises is one universally adopted, even by Mr. Galloway himself, who recommends the student to examine each group by itself—why not, then, each individual member?

Our author proceeds thus:—"In the plan I have adopted, the properties of the different members of each group are contrasted by placing them in parallel columns; the advantage of this is, that the student, after he has performed the experiments, is able himself to devise methods for the detection and separation of the different members; it places him, in fact, in the position of a judge who has to decide some cause after having heard all the pleadings." The plan here referred to consists merely of a further development of the plan of tabular statements. Mr. Galloway speaks of the reason and judgment exercised by the student using these tables. We think that the behaviour of the various bases and acids ought to be ascertained in a less narrow way, as pointed out above, and that the tables of properties are not unlikely to assist in making the student an "analytical machine." A careful selection of reactions ought to be presented to the beginner under each base and acid, while the analytical schemes subsequently given, ought not to do much more than suggest how the general and special tests may be successfully applied in the detection of the substances met with in analysis. The tables showing the reactions of the various bases and acids are very full, and present, without doubt, much information in a small compass, but they are not peculiar to the present Manual, and have been largely employed in other works.

Those features of his Manual to which Mr. Galloway specially directs attention, do certainly enable a student to acquire the power of performing analyses more rapidly and more easily than the ordinary system does: whether this power rests upon as secure a foundation of knowledge, is a matter of doubt.

The present edition is brought down in every important particular to the state of analytical knowledge at the present time. The photo-chemical method of Cartmell and the spectrum experiments of Bunsen will be found described very clearly and fully. Many of the special tests recently introduced into the laboratory, such as the excellent method of separating cobalt and nickel by means of nitrite of potash, will be here found in their proper places. We do not find, however, any reference to the use of binoxide of lead as an oxidizing reagent, although it is found extremely useful, in conjunction with nitric acid, for detecting traces of manganese carried down in the ammonia precipitate (Group iii.), and for ascertaining the presence of chromium in the same precipitate. In the latter case a small portion of the precipitate is boiled with binoxide of lead in the presence of a solution of potash, chromate of potash being thus formed. We have not been able in actual practice to carry out quite successfully Mr. Galloway's table for the analysis of Group iii.; we do not think that much reliance should be placed upon the solubility, when iron is present, of sesquioxide of chromium in cold soda-solution taken in connection with its subsequent precipitation on boiling.

With a few trifling exceptions, such as those we have noticed; the book is a thoroughly good Manual of Analysis, and can be mastered in a short time. It is highly appreciated in several large schools, and is found of very great use by Medical students.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

THIRD NOTICE.

Immediately following the examination of Mr. Szerelmey, the Committee were engaged in taking the evidence of Mr. Frederick Ransome, of Ipswich. It will be remembered that these gentlemen have urged rival claims in regard to the application of their respective processes to the Palace at Westminster; they were the first to undertake experiments in connection with the preservation of the stone actually forming part of the building; the results arrived at by them were capable of closer scrutiny and of more minute inquiry, and assumed, therefore, on this account a greater importance as compared with other and later suggestions which had not yet to the same extent been submitted to experimental trial.

During the month of August, 1859, the processes of Mr. Szerelmey and Mr. F. Ransome appear to have been first brought into direct competitive examination. At that period Sir Charles Barry sanctioned the treatment of the two bays on the river front, which were to be prepared each as an illustration of the capabilities of the process, with the view afterwards of applying on a larger scale that which should prove more successful in the preliminary trial. These specimens of protective workmanship have been reported on at the instance of the Government conjointly by Sir Roderick Murchison and Professor Faraday; been again inspected by the present Committee, and so frequently have formed a topic of discussion in the public journals, that it is needless now to remark more than the simple circumstance that the peculiar whitish appearance of Mr. Ransome's bay has been objected to, and that slight indications of efflorescence have made themselves apparent.

A still earlier application to the Houses of Parliament of the then recently patented process of Mr. Ransome dates as far back as the autumn of 1856, but the examples of that early period are not accounted by the inventor as successfully representing the capabilities of his mode of treatment from their having been the very first out-door experiments of the kind, and executed without a full knowledge of all the requirements. The earliest, and at the same time satisfactory, example of the process is afforded by the Baptist Chapel, Bloomsbury, which was coated in the year 1858. The whole front of the chapel is of Caen stone, which, prior to the application of the process, is said to have been in a state of very rapid decay. Mr. Ransome refers particularly to the treatment of the Bath stone façade of the Royal Mews at Buckingham Palace as being the most successful example in London, but this having been executed so recently as 1860, cannot, we think, yet be considered as exhibiting a satisfactory indication of the value of his process. The Custom-house at Greenock, built of sandstone, is stated to be in every way a fair illustration. This was coated in 1859.

In regard to the nature of the process employed by Mr.

Ransome, we are in possession of the full particulars made known in the patent specification, and every information has most promptly been furnished by the inventor as to the materials employed and the mode of manipulation. The Committee appear also to have been assisted in their inquiries with reference to the solution of a problem of considerable experimental difficulty, viz., the determination of the depth to which the chemical preparation actually penetrates the substance of the stone. This point has not yet been properly ascertained, and we propose later to take an opportunity of resuming the discussion on this question, which will be more appropriately introduced after the nature of the materials themselves has been announced.

The object of Mr. Ransome's process is to deposit by precipitation within the pores of the stone an insoluble silicate of lime; this compound consisting wholly of imperishable mineral constituents, is intended to afford protection to the stone by rendering it less absorbent for water, and by preserving it likewise from the influence of the atmosphere. Such insoluble compound is formed by double decomposition between silicate of soda and chloride of calcium, applied as solutions and in this order to the surface of the stone. It will be seen, therefore, that besides the insoluble silicate of lime, an equivalent proportion of chloride of sodium must always be produced, and it appears probable that to this second product must partially be ascribed the tendency already referred to of causing an efflorescence on the outside faces of the stone. It was found to be possible to construct a block or kind of artificial stone from powdered materials, moistened alternately with these two solutions, and the property possessed by such blocks of resisting for a time the action of water, was conclusively demonstrated by the inventor. So great indeed is the degree of protective action communicated by the presence of the calcareous silicate, that limestone which has been thoroughly coated with this substance, is said to remain unacted upon when immersed in weak acids. In proceeding to the manufacture of "artificial stone," modes of operating have been resorted to for the formation of a compact mass, which are no longer similarly applicable to the walls of the Houses of Parliament; thus Mr. Ransome describes the interesting results obtained by exposing to heat the mixture of materials above referred to, whereby varieties of even greater insolubility were produced.

The objection which does not appear to have been conclusively answered in regard to this process, has reference to the impracticability of producing by double decomposition, especially when one of the secondary products is soluble in water, a condition of surface which is totally unaffected by the rain or moisture of the atmosphere; thus it would appear difficult so thoroughly to close the pores of the stone, as to prevent the extraction of the chloride of sodium by water coming in contact with the face of the block. If removed, cavities, gradually widening, must be formed in consequence, which would permit of a subsequent and progressively increasing action upon the stone, due to the admission of the atmosphere. Moreover, the silicate of lime itself is a precipitate, somewhat gelatinous in nature, and occupies more bulk when moist, or at the time of its formation, than when it eventually becomes dry and sinks in the pores of the stone.

NOTICES OF PATENTS.

391. *Manufacture of Paper from a Pulp obtained from Wood.* E. H. Barre and C. M. J. Blondel. Nantes, France. Dated February 16, 1861.

This invention relates to an improved method of effecting the disintegration of wood for the purpose of obtaining therefrom ligneous fibres suitable for the manufacture of coarse paper. The patentees employ as the agent for facilitating the separation of the fibres nitric acid; but inasmuch as the strong acid would be liable to act too energetically upon the substance of the wood, it is preferred first to saturate the shavings or sawdust with water, and then to proceed to the treatment with nitric acid. In this manner the structure of the wood is softened, so that little mechanical aid is required to reduce it to the condition of supple ligneous fibre, and after a thorough washing, the material is ready for bleaching and general treatment like any ordinary paper pulp. But, with a view of economising the nitric acid, and at the same time obviating the inconvenience arising from the corrosive action of the acid in the wood upon the metal of the crushing rollers, it is preferred to convert the free nitric acid into nitrate of soda by adding a sufficient quantity of carbonate of soda immediately after the acid treatment. By evaporating the washing liquors a crude nitrate may be recovered, which, although containing organic matter and other impurities, will serve admirably for the preparation of new supplies of nitric acid by distillation with oil of vitriol. As the result of the oxidation by nitric acid of the resinous matters in the wood, a certain quantity of carbazotic acid is generated, which, on the addition of alkali, produces a dark brown colour; the pulp loses much of this simply by squeezing in a press, and afterwards can be thoroughly bleached by washing and the treatment with chlorine. As a means of expediting the course of these operations, the inventors prefer to employ heat in some of the processes, but several hours' crushing are requisite for the production of the finer kinds of pulp.

The addition of carbonate of soda to the woody matters while the acid is yet retained in their structural cavities, would serve an important end, which is not alluded to in the specification, although several matters of inferior moment are deemed by the patentees worthy of the full scientific explanation therein given. The principle of subjecting a vegetable structure to the alternate action of free acid and an alkaline carbonate was one originally proposed, and very successfully carried out, in connection with the manufacture of linen from flax. It was found that the carbonic acid gas liberated as the result of this action was capable of exerting a considerable amount of disruptive force, which was useful in tearing open the structure, and in facilitating the subsequent mechanical treatment for the separation of the fibres. The mode of proceeding now described differs only in the detail of substituting an expensive acid for that formerly employed.

408. *Preparation of Alkaline and Earthy Cyanides.* W. Clark, Chancery Lane, London. A communication. Dated February 19, 1861.

This patent refers to the production from ammonia of alkaline and earthy cyanides and ferrocyanides. The process of conversion is effected by passing a current of ammoniacal gas over a mixture of a carbonate of one of these bases with charcoal, pitch, tar, or other reducing agent, heated to dull redness in any suitable furnace. The employment of crude soda and potash, which contain a certain quantity of caustic alkali in addition to the carbonate, is specified as being particularly well adapted for producing this chemical reaction. A second claim relates to the preparation of cyanides or ferrocyanides by the reaction of a soluble sulphate upon cyanide of barium formed as above, whereby a precipitate of sulphate of baryta is produced. And, thirdly, the partial reconversion of this precipitated sulphate of baryta into carbonate by reduction, in the first place, with charcoal at a high temperature so as to form crude sulphide of barium, and passing carbonic acid gas through an aqueous solution of this product, when a certain quantity of carbonate of baryta will be regenerated and may be used in a repetition of the process.

The chain of chemical reactions called into play in the

transfer of nitrogen from crude ammoniacal matters into cyanides and ferrocyanides, is highly interesting, and likely to be susceptible of advantageous employment. From the frequency with which large proportions of sulphate of baryta are employed in the adulteration of pigments, one is almost tempted to believe that the lower commercial qualities of Prussian blue might be directly procured by the precipitation of ferrocyanide of barium with persulphate of iron.

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424. *Manure.* T. Richardson, Newcastle-on-Tyne. Dated February 20, 1861.

With the twofold object of producing a more concentrated and soluble variety of superphosphate manure, Mr. Richardson submits to a supplementary drying treatment the ordinary product of the action of sulphuric acid upon bones, bone-ash, coprolites, apatite, guano, and other commercial forms of phosphate of lime. The process is carried out simply by exposing the mass to a degree of heat sufficient to drive off the excess of water.

There would undoubtedly be a reduction both in bulk and weight, as the consequence of the expulsion of twenty per cent. or upwards of water from the ordinary superphosphate manure, and if care be taken in guarding the material from the action of an unduly high temperature, no loss of valuable constituents is to be anticipated. The volatilization of small quantities of ammonia might be the result of over-heating.

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440. *Doctors, Calico Webs, or Scrapers.* A. Crookes and H. Roberts, Sheffield. Dated February 22, 1861.

This invention consists in a method of protecting from corrosive influences the steel or other metallic surfaces of scrapers, and other parts of machinery employed in the printing of textile fabrics. These portions of metal are to be coated with silver, copper, or tin, by galvanic or other agency, that metal being employed in each instance which most effectually resists the action of the colours, or other chemical preparations brought into contact with it.

A suggestion so extremely simple must surely be capable of general application in many similar instances.

Grants of Provisional Protection for Six Months.

1692. Richard Jolley, St. John's Street, Smithfield, London, "An improved apparatus for heating, cooling, or drying, infusing, extracting, or absorbing vapours and gases for manufacturing, medical, or domestic purposes, and for preserving liquids and solids alimentary or otherwise."—Petition recorded July 3, 1861.

1956. William Clark, Chancery Lane, London, "Improvements in bleaching and clarifying saccharine matters, and in apparatus for the same."—A communication from Edouard Théophile de Gemini and Edmond Oswald de Gemini, Boulevart St. Martin, Paris.—Petition recorded August 6, 1861.

2197. Gustav Bischof, jun., Swansea, Glamorganshire, "Improvements in extracting copper and silver from ores containing those metals."—Partly a communication from Dr. Gustav Bischof, sen., University of Bonn, Prussia.—Petition recorded September 3, 1861.

2240. George Norris, Brondesbury Terrace, Kilburn, Middlesex, "Improvements in the manufacture of soap."—Petition recorded September 7, 1861.

2303. John Reeves, New York, U.S., "Improvements in electro-magnetic engines for obtaining and applying motive power."

Notices to Proceed.

1277. Robert King and Kenneth Robson, Granville Street, Sheffield, "Consuming and destroying smoke as emitted from engine or other chimneys, and from all other flues from which smoke is emitted."—Petition recorded May 18, 1861.

MISCELLANEOUS.

Arsenical Paper-collars.—Under the signature of *Author* (City), a letter has been addressed to us respecting paper-collars, which are now so extensively worn by gentlemen. He states that some arsenical preparation is employed in their manufacture, and a case has come under his notice in which a person has been injured by their use.—*Lancet.*

Blondin and Leotard at the Polytechnic.—The scientific principles upon which Blondin and Leotard perform their wonderful feats of balancing, receive from Mr. Pepper, the popular lecturer of the Polytechnic, an exposition which creates surprise on the part of his numerous and gratified auditory that what they have looked upon with wonder should be so simple. The art of balancing is shown by a variety of models and experimental and pictorial illustrations to consist in the preservation of the centre of gravity, which is found, for the purpose of demonstration, by applying the plummet, and drawing a straight line from the apex to the base of the object whose centre of gravity it is desired to determine. So long as the line of direction falls within the base there is no chance of a tumble, as was shown by reference to the famous leaning tower at Pisa, and by experiments with the wooden swords used by conjurors. Blondin on his rope at the Crystal Palace was then introduced, through the medium of photography and the microscope, and the use of his long balancing pole explained to the audience. A practical exemplification of the art is given, on a rope stretched across the platform by John Snell, waterman and boat-builder, of Hampton, who lately performed the difficult feat of walking across the Thames on a common towing rope. Snell walks backwards as well as forward, and carries a boy on his back. The trapeze feats, which have made Leotard so potent an attraction at Cremorne and the Alhambra, are also explained, and their principle shown to be identical with that of the pendulum.

ANSWERS TO CORRESPONDENTS.

F. L. Auld.—No answer to the communication has yet reached us.

J. P.—Your letter has been received, but we scarcely think its contents applicable to our columns.

Radiant Chemical Action.—A correspondent asks for information on this subject.

H. G.—Some of the constituents of rock-oil have been used in making soap, but not to any great extent. Most of the oils are unsuitable.

Peroxide of Hydrogen is prepared by adding a paste of peroxide of barium and water to a solution of hydro-fluosilicic acid. Filter through gum-cotton and concentrate by evaporation over oil of vitriol *in vacuo*.

Reginald R.—1. Any good chemical work will describe the way to make chloride of nitrogen, but you had better not try, unless you are a most expert manipulator, for almost everyone who has yet worked with it has been injured for life by its explosive violence. 2. We do not know. 3. Oxide of iron. 4. Griffin's gas-blast furnace.

Bluish Colour to Gun-barrels.—A correspondent wishes to know what chemical application will impart a bluish colour to gun-barrels. There is a method of imparting it so successfully that the difference cannot be detected between those newly done and those which have the colour imparted to them in their manufacture.

Iodide of Potassium.—Perhaps some of our subscribers will favour us with a reply to the following:—"Sir,—Can you inform me of the method generally adopted by the large manufacturers of iodide of potassium in the production of that salt, viz., what description and size of vessels it is evaporated in, and how heated, by steam or sand-bath? What quantities do they generally produce at one operation? Do they make their iodide of iron solution in large or small quantities, and how?"

J. A. Bower.—An electric light will be indispensable in exhibiting the phenomena to a large audience at once, but the plan generally adopted at lectures is to illustrate the remarks by coloured diagrams, and to exhibit the phenomena afterwards by means of small spectroscopes. We believe spectroscopes can be hired for the night, but you had better enquire of a maker.

THE CHEMICAL NEWS.

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Note on Fluorine, by T. L. PHIPSON, *Phil. Nat. Doct. Brussells University, Member of the Chemical Society of Paris, &c.*

IN 1857—58 I began a series of experiments in Paris, with the view of obtaining if possible the element fluorine. I have been constantly prevented from obtaining fluorine in a state of absolute purity chiefly on account of the impurities contained in the fluoride of potassium, permanganate of potash, and other substances which I had not then means of preparing myself in any quantity. The Parisian fluoride of potassium generally gave chlorine in abundance; so did the permanganate of potash, which I used with hydrofluoric acid to oxidise its hydrogen.[1] Indeed, I am led to believe that the ozone obtained by M. Boettger with permanganate of potash was simply oxygen mixed with chlorine. Some years ago (in 1856) I thought I had obtained ozone from permanganate of potash; but on introducing a little nitrate of silver into the gas, chloride of silver was immediately formed, and the odour and action upon iodide of potassium ceased.

Concerning fluorine, all I can say at present with certainty is, that it constitutes a colourless, incombustible gas, having a peculiar odour similar to that of oysters, a great affinity for water, which it decomposes in daylight, and having no action whatever upon glass. It whitens litmus like chlorine. It can be obtained by heating hydrofluoric acid with nitric acid in a retort, when fluorine is evolved, together with a certain quantity of nitrous vapours. If this experiment is made over water, a few nitrous fumes are at first perceived and a gas is evolved, but as soon as a certain quantity of fluorine is produced, the water rushes into the retort as if into a void; the whole apparatus is filled so quickly that it is impossible to perceive the passage of the liquid. This accident can be prevented by means of a proper tube. When a solution of fluoride of silver is decomposed by a current of chlorine gas, the chloride of silver precipitated contains fluorine, and does not blacken under the influence of the solar rays; when exposed to the light it becomes of a light brown tint, which is permanent even in sunlight. In this experiment a large portion of fluorine remains dissolved in the liquid, but it gradually decomposes the water, evolving large bubbles of oxygen gas, which appear to rise from the precipitate at the same time and not before the glass becomes attacked by the hydrofluoric acid formed.

Another mode of obtaining fluorine consists in heating with precaution a mixture of pure fluoride of calcium, a solution of permanganate of potash, and sulphuric acid. The gas evolved has a peculiar odour, something like that of oysters; it whitens litmus, dissolves in water, and does not attack glass, neither is the glass retort corroded in which the operation takes place. If peroxide of manganese is used, so much hydrofluoric acid is produced that, on the contrary, the whole apparatus is soon spoiled. By passing the gas obtained as above into a solution of soda I obtained a crystalline salt, which I take to be fluorate of soda, but which I have not yet examined thoroughly.

When a mixture of nitric acid, solution of permanganate of potash, and fluoride of potassium dissolved in water, is abandoned to itself for some days, a peculiar and very beautiful crystalline compound is formed: it consists of numberless small, flat, crystalline plates, of a golden bronze colour and metallic aspect, very much resembling certain varieties of mica; indeed this compound contains potassium, manganese, fluorine, and silicium, elements which we find in micas, and I look upon these crystalline plates as a sort of artificial mica.

[1] I have at last obtained some fluoride of sodium chemically pure. It was prepared by Mr. J. Christian, chemist to Messrs. Jackson and Townson, of Bishopsgate Street, London, and with it I intend to continue the experiments related in this paper, when circumstances will permit me to do so.

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page* 208.)

Determination of the Relation between the Atomic Weights of Nitrogen, Chlorine, Sulphur, Potassium, Sodium, Silver, and Lead.—In order to ascertain the reciprocal relations between the atomic weights of these seven bodies, I have performed the synthesis of,—

1. Chloride of Silver,
2. Sulphide of Silver,
3. Nitrate of Silver,
4. Nitrate of Lead,
5. Sulphate of Lead,

The analysis of,—

6. Chlorate of Potassa,
7. Sulphate of Silver;

and I have sought for the proportional number between,—

8. Silver and Chloride of Potassium,
9. Silver and Chloride of Sodium,
10. Silver and Chloride of Ammonium,
11. Nitrate of Silver and Chloride of Potassium,
12. Nitrate of Silver and Chloride of Ammonium.

By thus balancing simple bodies with simple bodies, simple bodies with compound bodies, and compound bodies with each other, I naturally arrive at results which can be controlled by each other.

Some of these determinations were undertaken many years ago; they have all been verified and completed during the last three years. I will commence the details of these researches with those which depend upon the metal silver, treating first of the preparation of pure silver, and the methods which I employed to assure myself of its purity.

Silver.—As silver has been the pivot, so to speak, of my researches, I have made every possible effort to procure this metal in a state of purity, and to make myself sure of its purity. For this purpose I have successively employed all the methods recommended to prepare pure silver. I have arrived at the certain conclusion, that all those which are capable of being executed on a large scale furnish an impure metal unless important modifications are introduced. All processes which depend upon the reduction of chloride of silver yield a metal containing copper and iron, unless, indeed, it has been redissolved three or four times successively in nitric acid, the solution, after diluting with twenty or thirty times its weight of water, being each time poured into aqueous hydrochloric acid, and the chloride of silver violently agitated in the liquid, as in the process of assaying. Experience has shown me that chloride of silver, free from copper and iron, can be obtained directly by pouring a cold solution of nitrate of silver diluted with thirty times its weight of water, into a slight excess of hydrochloric acid, washing the precipitate with cold distilled water, and then digesting the chloride, dried at the ordinary temperature, and finely powdered, in aqua regia. When well washed after this treatment, the chloride does not retain the slightest trace of either copper or iron; whilst, so long as the chloride of silver is in a curdy form, it retains in its pores, like coagulated albumen, some of the bodies which were dissolved in the liquid from which it was precipitated. Chloride of silver, however, when dried at the ordinary temperature and finely powdered, very easily yields to aqua regia foreign metals which contaminate it.

Whatever may be the purity of chloride of silver, it produces a metal which always contains silicium and iron when it is reduced by Gay-Lussac's method; that is to say, a mixture of chalk and charcoal.

The presence of these foreign matters is easily ascertained by dissolving a hundred grammes of silver in pure nitric acid in a platinum dish, and evaporating and fusing the nitrate. On dissolving the salt in cold water there is always a residue of silicic acid and sesquioxide of iron.

I have found as much as $\frac{15}{100000}$ths of silicium in silver reduced from the chloride by Gay-Lussac's process. M. Allard, Director of the Mint at Brussels, has kindly caused to be prepared for me in the laboratories of the Mint large quantities of silver by this plan, as recommended for obtaining silver for assay. In spite of all the care taken by M. Schoonjans, whose great skill I have had occasion to notice, the silver so produced contained traces of copper, iron, and especially of silicium. Upon analysing with extreme care the silver obtained by this method, I found when operating upon 200 grammes that after one treatment it contained between $\frac{10}{100000}$ths and $\frac{23}{100000}$ths of impurities; after two treatments, between $\frac{13}{100000}$ths and $\frac{17}{100000}$ths; after three treatments, between $\frac{8}{100000}$ths and $\frac{10}{100000}$ths. A comparison of this silver with metal obtained by other processes has led me to absolutely the same result. Amongst the determinations of the reciprocal relation between silver and chloride of potassium, there are three which were made with silver prepared by Gay-Lussac's method, and the impurities then make themselves apparent in a very evident manner. M. Dumas has estimated at a ten thousandth part the impurities contained in the silver supplied to him by the Paris Mint.

Without confidently asserting it, I suspect that the presence of so large a quantity of silicium in the metal so prepared is due to the action which silver has upon silicic acid. It is probable that at the temperature necessary for fusion silver reduces the silicic acid with formation of silicate and silicide of silver. Furthermore, the presence of carbon may favour the reduction of silicic acid and the formation of silicide of silver. One thing is certain, as I have frequently proved, that the vapour of silver attacks silicic acid and the silicates. White porcelain becomes coloured yellow or yellowish-brown, and increases very sensibly in weight, when there is directed upon it the vapour of silver disseminated by an oxidising flame.

Chloride of silver, purified by the above process, mixed with its own weight of pure dry carbonate of soda, containing a tenth part of pure nitrate of potash, when heated in a white unglazed porcelain crucible, with the precautions recommended by Berzelius for avoiding intumescence, yields an ingot of pure silver. This ingot, fused again with a tenth of its weight of pure nitre and borax, and then run into an ingot-mould lined with pipeclay, gives a bar of silver which retains scarcely any appreciable traces of foreign matters. This process requires great care, for when the mixture of chloride and carbonate is heated, if the temperature is raised too much at first, the mixture fuses, bubbles up, and is in danger of running over. I have, however, prepared in this way many kilogrammes of silver.

To effect with safety the reduction of chloride of silver in a white unglazed porcelain crucible, the latter should be placed inside a clay crucible. This is the way I have found most convenient for performing this operation:—I fill up the space between the two crucibles with calcined pipe-clay, powdered and mixed with 5 per cent. of fused and powdered borax. Under the influence of the heat, the borax fuses and solders the whole together. When the chloride of silver is reduced, the whole can be handled and the melted silver poured out as if it were one crucible. The great bulk which has to be heated before reaching the porcelain crucible prevents it cracking, and avoids loss of silver.

Besides this method of preparing silver, I have tried many other plans. One of them has been suggested to me by M. Liebig, who, indeed, has kindly prepared a certain quantity by this means for my researches. The process consists in reducing in the cold, by means of pure milk sugar, a pure concentrated ammoniacal solution of nitrate of silver, to which pure potash has been added until fulminating silver begins to be precipitated. After a short time a violet precipitate is formed, which is transformed into a mirror of silver, if the solution does not contain more than 10 per cent. of nitrate. If, on the contrary, it contains much more metal, the violet precipitate of silver remains. This precipitate, after being washed with water, is digested with aqueous ammonia, which removes the copper, if the silver contained any. When dried, it preserves its violet colour, and constitutes a peculiar modification of silver. Heated to 300° or 350°, the metal becomes incandescent, and then assumes its proper colour, being of a dead white. To reduce it to bars, I fuse it with a certain quantity of pure nitre and borax, and run it into an ingot-mould lined with pipe-clay.

I have prepared by this means more than three kilogrammes of pure silver, working upon a kilogramme at a time. I have always found the metal of a uniform purity, and identical with other pure silver. I say, with other pure silver, because it is not sufficient, as M. Péligot states in his memoir upon silver, to prove that the metal obtained by a certain process always has the same qualities, in order to be sure of its purity; it is

also necessary for it to be absolutely identical with pure silver prepared by other methods. Moreover, it may happen,—and this is the case in the reduction of pure chloride of silver by Gay-Lussac's process,—that the operation of reduction communicates to the metal as much impurity as has been separated by solution and precipitation.

I will now give the methods I have employed to obtain the silver with which I have controlled the metal used in my operations. I give them all, stating, however, that they are too tedious and furnish too small a quantity of silver to be used on a large scale.

The first plan consists in procuring the metal by the electrolysis of pure argentocyanide of potassium or of ammonium. I have prepared at least half a kilogramme by this plan, which is long and very costly. The deposit is made upon a surface of porcelain previously covered with a mirror of silver, by Liebig's method. For a positive electrode coke is used, obtained by heating the vapour of naphtha to redness. To obtain a nitrate of silver fit to prepare the cyanide, I dissolved in nitric acid the silver of $\frac{999}{1000}$ths produced at the Brussels Mint. The solution was evaporated to dryness and the salt fused. After cooling it was powdered and digested in cold water, taking care not to dissolve it all, for otherwise oxide of copper would come into solution. The solution of silver was allowed to stand for three or four days, filtered through double filter-paper, then digested with an excess of oxide of silver, and allowed to remain at rest for a sufficient time. This solution is diluted with water until it only contains a thirtieth part of its weight of nitrate, and poured into pure aqueous hydrocyanic acid until cyanide is no longer precipitated. The cyanide is shaken in the liquid to finely divide it, and then washed with water acidulated with nitric acid, and finally with pure water. The cyanide is diffused in an amount of aqueous cyanic acid equal to that used in its precipitation, and then pure ammonia or potassa is added to the mixture until the cyanide is all dissolved. When undergoing electrolysis the positive pole of carbon is surrounded with cyanide of silver, contained in a linen bag, purified by means of hydrochloric acid. I thus return silver to the liquid as fast as it is removed by electrolysation. I have been unable to find any foreign body in this silver after it has been fused in an unglazed porcelain crucible with a mixture of purified nitre and borax.

I have likewise made use, to prepare pure silver, of the reaction between finely-divided phosphorus upon a one-per-cent. solution of nitrate of silver. This action is very slow, but the metal, after having remained for a long time in an excess of solution of silver, and then being digested in ammoniacal water, yields, after fusion with purified nitre and borax, silver absolutely pure. By this reaction I obtained the first pure silver that I ever possessed.

Finally, I have prepared silver by the action of heat upon the acetate, which had been re-crystallised at least ten times. This metal, after fusion with nitre and borax, has appeared not so pure as the preceding.

The process recently described by M. Cavanna gives a very pure metal, but it is impracticable on the large scale. M. Péligot has already made the same remark.

I have discovered a very simple plan for ascertaining the purity of silver. The pure metal remains melted in the air at a sufficiently high temperature to volatilise it without being covered by any scum or coloration, and without giving a coloured vapour. Silver containing no more than the five hundred-thousandth part of iron, copper, or silicium becomes covered with a very strong and mobile scum when it is fused before a blow-pipe, fed with a mixture of illuminating gas or hydrogen and an excess of air. Silver containing scarcely appreciable traces of copper when volatilising in an oxidising flame always gives a coloured flame. This assay may be performed on charcoal or white-burned pipe-clay, or on porcelain, by means of a gas blow-pipe or a simple colipyle. The scoria derived from the impurities in the metal always forms upon the surface of the flattened spheroid caused by the fusion. After cooling, the foreign matter is found adhering to the silver near the point of contact of the metal with the support.

All the specimens of assay silver that I have been able to procure have yielded scoria more or less evident. This amount of impurity, however, in no way interferes with the results of the assays made at the Mint.

I have already said that I have ascertained by direct analysis the quantity and quality of the foreign matters present in silver prepared by Gay-Lussac's process, as described. As this method necessitates the sacrifice of 200 grammes of silver in each assay, I have replaced it by the wet process of assay, as used in Mints, taking the precaution to increase tenfold the quantity of metal experimented upon. For this purpose I have devised an apparatus, of which a drawing is given in my Memoir. It consists of two distinct parts,—a large glass reservoir, filled with a normal saline solution, and a large pipette, terminated at the upper part by a tube of about five or six millimètres internal diameter, to which is cemented a stop-cock, and at the lower part by a tube of two millimètres internal diameter. This pipette is replenished from below, and is fixed in a case filled with water kept at a uniform temperature. Filled twice up to a mark scratched on the upper tube, it contains at 10·2° an amount of common salt sufficient to precipitate ten grammes of the purest silver I have been able to procure. I will not now enter into the details of these experiments. I will give an account of all the precautions which I have taken to ensure the almost absolute accuracy of the results, when speaking of the proportional relation between silver and chloride of potassium, sodium, &c.

Before leaving this subject, I must still mention the form in which I have employed the silver used in my experiments. All the metal has been fused and cast in an ingot-mould, lined with white pipe-clay. To detach the pipe-clay, the surface of the bars is rubbed with sharp white sand. They are then heated to dull redness and covered over with caustic potassa, which is kept in a fused state for at least a quarter of an hour. The adherent pipe-clay being in this manner attacked, the bars are suddenly plunged into water. The silicate formed on the surface being thus detached, the bars, after a second scrubbing with sharp sand, are fit for use. These bars, before being employed, are treated with boiling hydrochloric acid, washed first in cold aqueous ammonia, then in pure water, and finally heated to redness on plates of pure silver.

My experiments have rendered it necessary for the silver to be in the form of small lumps, from two to twenty-five grammes in weight, in the form of sheet, and in a certain state of division to make up weights previously calculated. I obtained the small lumps by cutting the ingots with a chisel on an anvil of polished cast steel. The turnings and filings obtained from the ingots by means of a lathe and file have furnished the finely-divided silver. To separate the iron adhering to the silver when cut with the chisel, lathe, or file, I digest these different forms of the metal in a close vessel for

twenty-four hours, and at a temperature of 60° to 80°, first with strong hydrochloric acid, and then with pure ammonia. The silver is finally washed with absolutely pure water, heated to redness on a plate of pure silver, and immediately put into bottles with well-fitting stoppers.

Having found that the silver, after having been rolled at the excellent mills belonging to our Mint, contained iron, which was absent before rolling, I took the precaution to have all the silver which I required in the form of sheet rolled between two plates of pure silver. It is only at the expense of the surfaces of the two plates which touch the cylinders of the mill that I have been enabled to protect the surface of the inner plate from contamination with all foreign metal. The plates of silver employed in the synthesis of the sulphide and in some of the syntheses of the chloride of silver were thus obtained. The laminated silver was likewise heated to redness in the air, and enclosed whilst very warm in a well-stoppered bottle.

I thought for a long time that, after having taken all the precautions detailed above, I had succeeded in obtaining silver absolutely pure. An experiment has, however, undeceived me. When performing the synthesis of nitrate of silver upon about 400 grammes of this metal, I have still found the presence of some traces of silicium, not, however, more than 2 parts in 100,000.

(To be continued.)

Analytical Notes, by M. H. Rose.

Precipitation of Mercury in the State of Protochloride by Phosphorous Acid.—The best method for estimating mercury is to precipitate it in the state of protochloride by phosphorous acid. When the liquid contains free hydrochloric acid the temperature may be raised to 60° without the protochloride of mercury being reduced to the metallic state by phosphorous acid. The precipitated protochloride is not immediately formed in very weak liquids; it is necessary to leave the mixture undisturbed for twelve hours. The chloride deposits itself readily, especially when the liquid is sufficiently acid.

The precipitate is to be collected on a filter, washed with cold, or even hot water, and dried at 100°. This process is very applicable to cases where the liquid contains much nitric acid. Only the solution must then be diluted with a sufficient quantity of water.

The mercury can be easily separated by hydrochloric acid and phosphorous acid from copper, cadmium, zinc, and even bismuth, antimony, and arsenic. When the liquid contains bismuth a large excess of hydrochloric acid must be added to prevent the precipitation of oxichloride of bismuth. The mercury being separated in the state of protochloride, the bismuth is precipitated in the filtered liquid as oxichloride, then reduced to the metallic state by fusion with cyanide of potassium.

If the liquid contain antimony, this body is to be retained in solution with tartaric acid, which does not hinder the precipitation of the mercurial chloride.

Separation of Mercury and Lead.—The preceding method is not applicable to the separation of mercury and lead. A portion of the lead is precipitated in the state of chloride with the protochloride of mercury. A better plan for analysing a mixture of the salts of these two metals is to add sulphuric acid, and then alcohol forming about $\frac{1}{6}$th of the volume of the liquid. If this does not contain sufficient hydrochloric acid, and if the proportion of sulphuric acid is insufficient, yellow sub-sulphate of mercury may be precipitated, which is avoided by the addition of sulphuric acid. The sulphate of lead requires washing with weak alcohol acidulated with sulphuric acid.

Separation of Mercury and Silver.—Add a sufficient quantity of hydrochloric acid to the diluted solution. After the deposition of chloride of silver, decant the supernatant liquid; then heat the chloride precipitate with a small quantity of nitric acid, add some water and a few drops of hydrochloric acid, and then filter. Precipitate the mercury from the filtered liquid by phosphorous acid.

Reduction of Mercuric Chloride by Alkaline Formiates.—M. de Bonsdorff proposed to precipitate mercury as protochloride by alkaline formiates. This method may lead to completely erroneous results, as alkaline formiates do not invariably reduce bichloride of mercury. The affinity of mercuric chloride for alkaline chlorides is so great that when these bodies are present the ordinary reactions of mercury are not produced. When a liquid contains much hydrochloric acid, an alkali does not precipitate oxide of mercury from it. Sulphuric and nitric acids have the same effect. Such a mercuric solution, containing a large excess of potassa, is not precipitated by sulphide of ammonium unless the base has been previously supersaturated with an acid.

The same remark applies to the chlorides of other precious metals, particularly to chloride of gold. In presence of a considerable excess of hydrochloric acid or alkaline chlorides, a small quantity of salt of protoxide of iron or oxalic acid does not suffice to reduce chloride of gold. A large excess of the re-agent is necessary.

Estimation of Mercury in its Solid Combinations by Distillation.—In estimating mercury by distillation it is necessary, especially if the metal is in the state of chloride or sulphide, to take certain precautions, without which a portion of the sulphide or chloride would volatilise without decomposition. The operation is conducted by introducing into a glass tube capable of resisting fusion, closed at one end, and measuring from 35 to 50 centimètres in length, a column of bicarbonate of soda, then one of quick lime, and then a well blended mixture of a mercurial salt and quick lime, and finally a column of quick lime. The open end of the tube is drawn out and bent round so as to enter a small flask containing water. The tube is heated as if for an organic analysis, commencing at the open end and finishing with the bicarbonate of soda. The operation ended, cut the bent end of the tube. Collect all the mercury in the flask, dry with paper, and afterwards over sulphuric acid, and then weigh it.

There is no need to replace the quick lime by hydrate of lime. That would occasion all the inconvenience of an analysis of a sulphuretted combination of mercury. The water, acting on the sulphide of calcium, would form sulphuretted hydrogen, which, by dissolving in the water of the receiver, would in time transform a portion of the reduced mercury into sulphide. It is even advisable in this case to replace the bicarbonate of soda by carbonate of magnesia.

Combinations containing iodide of mercury are not entirely decomposed when treated as above. Biniodide and protoiodide are condensed in the extremity of the tube simultaneously with the metallic mercury.

To analyse these combinations recourse must be had to metallic copper, the operation being similar to that with quick lime.—*Poggendorff's Annalen.*

On Rubidium and Cæsium,[1] *by M.* Bunsen.

In addition to the facts which we have already published on the subject of these two metals, discovered by M. Bunsen, by means of spectrum analysis, we add the following:—

The equivalent of rubidium is 85·36 (H = 1), more than double that of potassium; metallic rubidium is even more electro-positive than potassium,—it amalgamates easily and decomposes water in the cold.

The hydrate of rubidium, RbO.HO + Aq, is soluble in all proportions in water and alcohol. When heated it fuses in its water of crystallisation, becoming reduced to the state of RbO.HO, which is fusible at a higher temperature without losing weight. It acts like caustic potash, attracting water and carbonic acid from the air, and dissolves in water with disengagement of heat.

The carbonate, $RbO.CO_2$ + Aq, forms ill-defined crystals, of strong alkaline reaction, fusible by heat in their water of crystallisation, and becoming anhydrous. This salt is fusible, deliquescent, and attracting from the air a second equivalent of carbonic acid. The aqueous solution saponifies the skin exactly like carbonate of potash.

The bicarbonate, $RbO.2CO_2$ + HO, forms brilliant prisms, unalterable in the air, having a slight alkaline reaction, and a saline taste not at all caustic.

The nitrate, $RbO.NO_5$, does not crystallise in rhombohedral prisms like saltpetre, but in prisms with a hexagonal base, which is a second form of nitrate of potash. It dissolves in 5 parts of water at 0° C., and in 2·3 parts of water at 10° C.

The sulphate, $RbO.SO_3$, is isomorphous with that of potash. At 7° C. it dissolves in 2·4 times its weight of water, and is, consequently, more soluble than sulphate of potash, which requires 10·4 times its weight of water to dissolve it. With sulphate of magnesia it gives a beautiful octohedral salt, and with sulphate of cobalt another double salt, in fine crystals, isomorphous with $CoO.SO_3 + KO.SO_3 + 6HO$.

The bisulphate of rubidium can be fused at a moderate temperature without decomposition, but at a higher temperature it is reduced to the neutral salt.

The chloride of rubidium is cubic, but crystallises with difficulty. It is fusible and volatilisable at the extremity of a platinum wire. From 1° to 7° C. it dissolves in 1·2 to 1·3 parts of water; KCl requires 3·4.

The double chloride of platinum and rubidium, $RbCl.PtCl_2$, is a crystalline powder composed of microscopic octohedra. It only differs from the double chloride of platinum and potassium by its less solubility; it only dissolves, indeed, in 158 times its weight of boiling water, whereas the potassium salt only requires 19 times its weight.

Cæsium (from *cæsius*, sky-blue, on account of the colour of the ray which it produces in the spectrum). The double chloride which it forms with platinum is still less soluble than that of rubidium. Its equivalent ranks by the side of those of iodine and gold, 128·4, and is, consequently, one of the highest.

The hydrate of cæsium, CsO.HO + Aq, is deliquescent. When heated it loses an equivalent of water, attacks platinum, volatilises in a spirit-flame, and easily dissolves in alcohol.

The carbonate, $CsO.CO_2$ + Aq, crystallises badly at 19° C. It dissolves in 9 times, and at 78·4° C. in 5 times its weight of absolute alcohol. It is very caustic, liquefies in the air, and is transformed into bicarbonate. It is soluble in all proportions in hot water.

The bicarbonate crystallises in brilliant prisms.

The nitrate is anhydrous, like that of potash, with which it is isomorphous. It has the taste of saltpetre, as also has the nitrate of rubidium.

The sulphate of cæsium is also anhydrous, and crystallises badly. At 2° C. 1 part of this salt requires 0·63 parts of water to dissolve it. It forms double salts with the magnesian sulphates, and these double salts are isomorphous with those formed with the same sulphates and the sulphates of potash and ammonia. With sulphate of alumina the sulphate of cæsium forms a very brilliant octohedral alum.

The chloride crystallises in cubes, but it is distinguished from those of potassium and rubidium by being deliquescent, like the chloride of lithium. It is fusible and volatile at a comparatively moderate temperature.

Cæsium is less abundant than rubidium, which, however it generally accompanies; the richest source is the mineral water of Durckheim. 10 kilogrammes of this water contain 2 milligrammes of chloride of cæsium; and it has been from the residue of the evaporation of this water that I have prepared it, by precipitating it with bichloride of platinum, and submitting the alkaline chloroplatinate to successive exhaustions with boiling water until only the chloroplatinate of cæsium was left, this, as we have seen, being the most insoluble of all, and possessing also the highest equivalent.

The lepidolites contain only traces of cæsium, but, on the contrary, they are rich in rubidium, and it is from these that M. Bunsen has prepared the latter. The lepidolite from Rosena (Moravia) contains two-thousandths of its weight of oxide of rubidium, and that from Saxony appears still richer. Probably all the saline mineral waters contain it; that of Durckheim contains two-millionths, and the mother-liquor about four hundred-thousandths of chloride of rubidium. Commercial potash, however, does not always contain it.

[1] *Annal. der Physik und Chem.*, t. cxiii., p. 337.

On the Preparation of Nitrate and Nitrite of Ethyl, by M. Carey Lea.

Nitrate of Ethyl.—The tendency of alcohol to decompose nitric acid is so great that while we have any number of processes for obtaining nitrite of ethyl, Millon's is the only one known for forming the nitrate. But Millon's process fails much oftener than it succeeds (such, at least, has been my experience), in consequence of the proportion of urea directed to be used being much too small.

Millon's process, as quoted in Kolbe's "Organische Chemie," directs to distill equal weights of alcohol and of colourless nitric acid, specific gravity 1·401. Not to operate upon larger quantities than 120 to 150 grammes, and to add a little urea to the above quantity, at most ("höchstens") 2 grammes of urea.

Conducted as above, the operation succeeded with me but once out of four or five times. But by using a large quantity of urea, three or four times as much, or even more, success invariably follows, and there results a great saving of urea, because when the process fails, the materials, urea included, are entirely lost, whereas when conducted as just described, very little urea is consumed. It is only necessary to add fresh acid and alcohol, after the first proportion has been distilled to about one-fifth, and the process may be repeated almost indefinitely, with the occasional addition of a little urea to keep up

the proportion. The product in the second and subsequent operations is much larger than in the first.

Nor have I found it necessary to operate on the small quantities above mentioned, but have habitually used quantities amounting to 400 to 500 grammes, and should not hesitate to employ still larger ones. It is, however, more convenient to use the above quantity, and replace the material as fast as exhausted.

The facility with which nitrate of ethyl can be obtained by the above process must, I think, give it a decided advantage over the iodide of ethyl for the preparation of the ethyl bases, in the manner which I have recently described.[1] The lower equivalent of nitric acid as compared with iodine is a matter of considerable importance; 100 parts of iodine are capable of holding in combination something less than 23 of ethyl, whereas 100 parts of nitric acid combine with over 53 of ethyl,—a material point, as the iodine on the one hand and the nitric acid on the other are merely the vehicles for bringing about the ethyl substitution. In operations in pressure-tubes, where space is valuable, this is an important consideration; in an economical point of view also the advantage appears to be greatly on the side of the nitrate of ethyl.

Nitrite of Ethyl.—The action of nitric acid on alcohol in the preparation of nitrite of ethyl may be conveniently moderated by protosulphate of iron, and the nitric acid reduced by that agent instead of at the expense of part of the alcohol. The proportions which I have used are, nitric acid, specific gravity 1·37, 90 cubic centimètres; alcohol, of 90 per cent., 150 cubic centimètres; ferrous sulphate, 45 grammes. The product is very large; the distillate, on being shaken up with water, yields more than half its bulk of nitrite of ethyl. The latter is not perfectly free from aldehyde, but more so than that obtained by some other processes. The action is perfectly quiet to the last, and the distillation may be carried on rapidly.—*American Journal of Science*, No. 95.

TECHNICAL CHEMISTRY.

On the Artificial Colouring Matters derived from Aniline, by M. E. Kopp.

(Continued from page 210.)

Believing in the identity of fuchsine and azaleine, MM. Persoz, de Luynes, and Salvétat endeavoured to separate the pure colouring matter from them in the following way:—They mixed each of the products with six or seven times its volume of alcohol, and then filtered. To each alcoholic solution they added pure ammonia as long as any precipitate was formed, and the liquor became colourless or of a light amber. They then filtered again to separate the precipitate, which in the case of fuchsine consisted of stannic oxide, and, in the case of azaleine, of resinous matter. The ammoniacal solutions contained the whole of the colouring matter. These were saturated with acetic acid, and then a saturated solution of bichromate of potash was added, which produced a red precipitate. This was collected and carefully washed. As long as the washings contain saline matters they run away uncoloured, except by the bichromate; but as soon as the saline matter is gone, the precipitate begins to dissolve. If, now, the washing be made with hot water, a solution is obtained charged with the colouring matter, which is the same, whatever may have been its origin. Baryta, or lime, may be substituted for ammonia in the above experiment.

The authors of this report, without denying that the colouring matter may at times play the part of a base, contend that it quite as often, and perhaps oftener, plays the part of an acid. In fact, under the influence of acids the fuchsine, or rather fuchsic acid, always dyes, for under these circumstances it is free. But fuchsic acid, combined with powerful bases, such as ammonia, potash, and soda, forms colourless compounds, which only dye when an acid is present to displace the base and fit it to unite with the fabrics. Fuchsic acid, indeed, behaves under these circumstances exactly like carthamic acid.

The aqueous solution of the colouring matter prepared in the method before described behaves with re-agents in the following manner:—Caustic alkalies and the alkaline carbonates remove without destroying the colour, for it re-appears on the addition of an acid. Chloride of platinum at first produces only a cloudiness in the solution, but, after a time, a purple precipitate forms. Chloride of gold gives a deep purple precipitate immediately. Sulphocyanide of potassium, after some time, gives a precipitate like purple of Cassius. Stannous chloride in the cold almost decolorises the solution; warm, it gives a colour like wine lees, and a few drops of acetate of soda precipitates a rose-coloured lake. Stannic chloride in the cold modifies the substance, altering the colour, the change being more pronounced when a warm solution is used, the precipitate lake being of a dirty rose colour. Manganate and permanganate of potash produce no precipitate, but give a fawn colour to the solution. Hyposulphite of soda gives a violet shade to the colour. Chlorine at first blues and then decolorises the solution. Chloride of lime partially decolorises it in the cold, and completely when warm, the stannous chloride no longer reproducing the colour. Saturated solutions of alkaline salts precipitate the liquor, as soap is precipitated by some saline matters. Sulphurous acid decolorises the solution, but an oxidising agent carefully employed restores the colour.

The purified colouring matter from fuchsine contains no chlorine, and, whatever the origin of the red matter, it always contains about 70 per cent. of carbon and 13 per cent. of nitrogen.

The distinguishing characters of the red colouring matter, fuchsine, and the violet colouring matter, indisine, may be summed up as follows:—

Fuchsine is soluble in ammonia; indisine is not. Fuchsine forms a yellow solution in suphuric acid; indisine gives a blue. Fuchsine is decolorised by sulphurous acid; indisine is not changed. Lastly, indisine, being the result of the oxidation of aniline, which is one of the derivatives of indigo, presents so many analogies with the last body, that, forgetting for the moment that indisine is a violet colour, it might be taken for indigo when witnessing in it all the phenomena of oxidation and reduction so easily effected with indigo.

M. Kopp objects to the use of bichromate of potash in the process for the purification of fuchsine and azaleine proposed by MM. Persoz, de Luynes and Salvétat, and thinks it possible that the action of this body may produce the identity which they seek to establish. Is it not possible, he asks, that the colouring matters not identical, yet extremely alike in composition and properties, may, under the influence of such an agent as bichromate of potash, be converted into one and the same compound, just as starch, dextrine, and various

[1] Chemical News, August 17, 1861, No. 89, Vol. iv. p. 88.

kinds of sugar are converted into oxalic acid by the action of an oxidiser? M. Kopp, therefore, prefers a method of purification in which only entirely neutral bodies, such as sulphide of carbon, benzine, and alcohol, are made use of. A process of this kind has been invented by M. Schneider for the purification of fuchsine and azaleine. To purify azaleine, M. Schneider first rubs together in a mortar, for about ten minutes, three parts of the rough product and three or four parts of cold water. The mixture is then allowed to stand for an hour, and then the supernatant liquor is poured away. This washing is repeated at least six times, the object being to get completely rid of the salts of mercury and aniline, more or less of which are always present. A little of the colouring matter is lost in this way, but not much. The azaleine must next be dried. It is then rubbed with about an equal quantity of sulphide of carbon for ten minutes. At first the colouring matter is very sticky and difficult to rub, but by degrees it becomes almost pulverulent, and then yields nothing more to the sulphide, which may be poured away. This operation is repeated several times. The mixture may then be thrown on a filter to drain. What remains on the filter is dried in the air, reduced to an impalpable powder, and then treated with pure benzole seven or eight times, or as long as the benzole becomes coloured. The powder is then dried again in the air. Lastly, 40 grammes of this dry impalpable powder are treated with 400 grammes of alcohol. A quarter of the alcohol is added at a time, and, after stirring together for about ten minutes, the solution is poured off into a large bottle, and another quarter of the alcohol is added, and so on, to dissolve the whole of the colouring matter. 440 grammes of cold distilled water is now added, the mixture well shaken, and then allowed to stand until the following day. All the foreign matters and some of the colouring matter are precipitated by the distilled water. After filtering, the solution of the now perfectly pure colouring matter is evaporated on a water-bath to about a sixth of its bulk, and then allowed to cool. The mother liquor is decanted on the following day, and at the bottom of the dish will be found a crystalline pellicle, scattered over with brilliant scales. The whole is dried, in the air for a couple of days, and finally on a water-bath.

The process for purification of fuchsine differs but little from the above. Fuchsine is much more soluble in water than azaleine; to avoid loss, therefore, it is necessary to use iced water in the first washing. The mass is then exhausted with alcohol, which leaves 30 or 40 per cent. of insoluble residue. The alcoholic solution is then evaporated or distilled to dryness, and the dry product treated as in the case of azaleine.

Passing from the red and violet-red colouring matters, M. Kopp proceeds to notice the reports of MM. Wilm and Scheurer-Kestner on aniline violet. This is obtained by the action of bichromate of potash (Perkins) or peroxide of manganese (Kaye) on a salt of aniline, or, preferably, by adding hydrochlorate of aniline to a solution of chloride of lime (Beale and Kirkham). The violet precipitate in these cases is accompanied by a brown colouring matter and a resinous body. The brown matter is the most abundant product, and the greater part of it remains in solution in the mother liquor; it dyes silk and wool a maroon colour without the intervention of a mordant; it is easily separated from the violet in consequence of its solubility in alkalies, in which the violet matter is insoluble.

The resinous body is insoluble in water, weak alcohol, and acetic acid, but soluble in absolute alcohol, sulphide of carbon, ether, and benzole. As the violet matter is insoluble in the three last named, they may be used to separate the resinous matter from a mixture of the two. Aniline violet itself is soluble in boiling water, alcohol, wood-spirit, acetone, aniline, and acetic, hydrochloric, sulphuric, and tartaric acids. Water, and especially when charged with neutral saline matters, caustic alkalies, or even metallic salts, precipitates it from these solutions. In the latter cases, the colouring does not combine with the metallic oxides to form lakes.

The alcoholic violet solution is decolorised by chlorine water, but the colour is restored by sulphurous acid; sulphurous acid and the sulphites do not decolorise it; but the colour is discharged by the combined action of zinc and sulphurous acid. Chlorine now restores the colour, but with some alteration; it is redder and no longer possesses the violet shade.

Heated on a plate of metal, dry aniline violet appears to volatilise and give red vapours; but crystals cannot be obtained by sublimation either *in vacuo* or under the ordinary pressure of the atmosphere. It seems to decompose into aniline (which carries away with it some of the violet matter unchanged) and a good deal of carbon. A solution of the pure violet matter in strong acetic acid yields prismatic crystals, which, when dried, have a more brilliant green shade than the dried amorphous mass from the evaporation of the alcoholic solution.

The analysis of aniline violet by Wilm yielded results from which he calculated its formula to be $C_{26}H_{17}N_3O_2$; and the reaction which takes place in its formation he represents as

$$3\ C_{12}H_7N + 6\ O = C_{36}H_{17}N_3O_2 + 4\ HO.$$

The analyses of Scheurer-Kestner, however, gave results which led to the formula $C_{30}H_{14}N_2O_2$, according to which the reaction will be

$$5\ (C_{12}H_7N) + O_8 = 2\ (C_{30}H_{14}N_2O_2) + NH_3 + 4\ HO.$$

On some Applications of Ebonite, or Hard India-Rubber,[1] *by* H. A. Silver.

The material known as hard india-rubber, vulcanite, horn-rubber, or, in its most perfect condition, as ebonite, was first obtained by Hancock, although its discovery was also effected by the independent researches of Goodyear. Ebonite consists of india-rubber, vulcanised with sulphur at a high temperature, which is continued for several hours. As in the case of caoutchouc, or pure india-rubber, the applications of this *matériel* were, until lately, extremely limited. It is principally met with in the form of combs, paper-knives, and penholders; but the peculiar properties it possessed render it available for far more important uses. Its acoustic qualities have been utilised in the construction of stethoscopes, and render it well adapted for ear-trumpets and for flutes, and several other wind instruments. Like horn or ebony it may be turned in a lathe, although in practice it is found preferable to produce it in moulds of any desired form. It is a most powerful, probably the most powerful negative ideo-electric; and, from not being liable to fracture, it advantageously replaces the glass plates of electrical machines. From this fact, and from its possessing no hygroscopic attraction for moisture, it may be inferred that it is also an excellent insulator of electricity. Apart from its application in the form of insulators for overground wires, it is found most useful

[1] Abridged from a Paper read before the British Association.

in the insulation of practical and philsophical electrical apparatus, samples of which are here present.

A recent and valuable application of ebonite is in the construction of "nitrate baths" and other apparatus for use in photography, and also for battery cells. In vessels of this material the nitrate of silver may, with suitable precautions, be boiled without affecting the solution. This process is sometimes necessary, and cannot be performed in vessels either of glass or gutta-percha. The battery cells, indestructible in other respects, resist even the intense fluid heat produced by the addition of concentrated sulphuric acid to water. The advantage offered by vessels combining the resistance to fracture of gutta-percha with the negative chemical properties of glass or porcelain, and capable of withstanding a temperature considerably above 212° without danger of bulging or softening, will be duly appreciated by photographers.

In an ornamental point of view, ebonite has been used for covering articles of iron or steel, such as buckles for belts or harness, thereby rendering them unalterable by oxidation, and substituting an equally beautiful material for the metallic surface. It has been employed as an imitation of buckhorn handles for knives, and as a substitution for horn or ebony in buttons, napkin-rings, and various ornamental work. In the form of bracelets and similar ornaments it advantageously replaces jet, to which substance it bears great resemblance without being liable to chip or fracture. It has also been used for mounting jewellery.

PHYSICAL SCIENCE.

On Thermo-Electric Currents in Circuits of One Metal,[1] *by* FLEEMING JENKIN.

IN the course of some thermo-electrical experiments, I was led to examine the effect of various distributions of heat in circuits formed by one metal. I verified the conclusion arrived at by Professor Magnus, that no distribution or movement of heat in a continuous and homogeneous piece of metal will produce a current of electricity.

I also repeated, with some variations, the experiments of Seebeck and Magnus, which show that, if one end of a wire be heated, the other remaining cold, a momentary or transient current of electricity will be developed when contact is suddenly made between the hot and cold ends; the direction of the current depending on the metal employed.

I found that I could obtain permanent currents in the same direction from each metal if I simply looped the two ends of the wire together, and heated one of the two loops; and, moreover, that the current was much greater when there was a loose contact between the two wires than when the two loops were tightly drawn together. It is to these currents, due to loose contact between a hot and cold wire of the same metal, that I wish to direct the attention of the Section. I will first shortly describe the apparatus used, and the experiments which showed the existence and importance of these currents, and I will then endeavour to repeat some of the experiments before you. I used a reflecting galvanometer of the form constructed by Professor W. Thomson, of Glasgow. A very light mirror, attached to a very small magnet, hung inside—the galvanometer coil reflects the light of a lamp upon a scale about two feet off. Very small deflections of the magnet are distinctly shown by the movement of the reflected spot of light, while the slight inertia of the moving parts has great advantages when rapidly varying currents are to be observed. A common spirit-lamp was used to heat the wires, which were from 0·02in. to 0·05in. in diameter.

When two pieces of similar copper wire are connected with a galvanometer, and the end of one wire is heated, a momentary current flows from the hot wire across the joint to the cold one whenever they are suddenly brought in contact. While repeating this experiment, due to Seebeck and Magnus, I found that if the two ends of two such copper wires (being equally oxidised and annealed) were looped together and held tightly in contact, little or no current could be observed when one of the loops was heated in the flame; but when the two loops were separated, I observed a momentary current in the same direction as that produced when the hot and cold wire were suddenly joined, *i.e.*, from hot to cold across the joint. This fact excited my attention, and led me to consider what the acts of making and breaking contact could possibly have in common. I reflected that when two wires are approaching or receding, they equally pass through points at every possible distance (within limits) one from the other. Thus I thought that the relative distance between the two wires might be the peculiarity which, being common to the two acts, might produce similar effects in each case. I, therefore, tried the effect of a loose contact between the two wires, resting the one wire very lightly on the other instead of pressing or pulling the two together.

A permanent current was at once produced so strong as to hold the deflecting magnet of the galvanometer against its limiting stops. I then introduced resistance coils into the circuit, for the purpose of reducing the deflection, but, to my surprise, it was not until I had added a resistance equal to that of 2000 miles of the Red Sea cable, or about 1000 miles of the common No. 16 copper, that I reduced the deflections within the range of my galvanometer.

The current could be maintained through this resistance for twenty minutes at a time. Not perfectly constant, indeed, but not wavering more than was inevitable from the varying pressure given by the hand to the two wires. The current was strongest when one end of the wire was white hot, the other being dark red.

I varied the experiment in many ways, using different galvanometers and different copper wires, but always with one result. A tight contact gave a barely sensible current; a loose contact gave a current which could be maintained permanently equal to that which would be produced through a similar resistance by the eighth or tenth part of a Daniell's cell—a strength sufficient to signal through a cable to America, if ever one be laid.

I next tried the same experiment with iron wires. Analogous results were obtained, but with one remarkable difference, viz, that the direction of the current was from cold to hot across the joint, instead of from hot to cold, as in copper; moreover, a very sensible current was always observed in iron, even when the two loops were firmly held together: it seems possible that this effect is only a residue of the effect caused by a loose contact, the hard oxide of iron precluding a perfect metallic contact between the loops. The effect is increased at least fivefold when a loose contact is made.

The maximum electro motive force to be obtained from iron is about one-twentieth that given by copper, and acts in the opposite direction. Platinum gives no current with tight contacts; with loose contacts a weak

[1] Read before the British Association.

current flows in the same direction as that given by copper. I must here warn anybody disposed to repeat these experiments that the resistance of the loose contact is itself considerable, and if the whole circuit, including the galvanometer be of small resistance, the strongest deflection will be obtained with comparatively tight contacts; for, although the electro-motive force is increased by loosening the contact, the total resistance of the current may be increased in a still higher proportion, and the strength of the current will then diminish. This effect is analogous to the well-known fact in voltaic electricity that, by the addition of small cells in series to a battery with large surfaces, the strength of the current may be reduced if the total resistance of the circuit be small, but will be increased if the total resistance be large. Thus the effects of loose contacts are best seen on a sensitive galvanometer with a large resistance in circuit.

These phenomena may apparently be due to a thermo-electric absorption of heat at the joint, or to a chemical effect on one of the wires, the air or oxide acting as an electrolyte. The opposite direction of the current in iron and copper, however, gives a reason for believing that chemical action is not the cause of the current. The decided effect obtained with platinum is another argument for this belief. It is, moreover, well established that any variation in the molecular structure of a metal causes one part to become thermo-electrically positive or negative with respect to the other; thus thermo-electric couples can be made of hard and soft wire of one metal, or of crystals arranged axially and equatorially; the current being supported by the Peltier absorption and evolution of heat. Now, discontinuity is the greatest possible change which can occur in the molecular structure, and it therefore appears not improbable that the currents due to loose contacts, or, in other words, to discontinuity, may be due to the same cause as the currents due to varying temper, or to crystalline structure; that is to say, to absorption of heat where the change of structure occurs, heat being evolved in other parts of the current at a lower temperature. I hope soon to decide this question by further experiments in various media with definite pressures at definite temperatures.

When various metals are combined striking effects are produced, the common thermo-electric current from the joint being often increased fifty or a hundred-fold; when loose contacts are substituted for tight contacts the direction of the current is also frequently reversed.

The results of these combinations are necessarily complicated, and require further experiment and analysis before publication.

In the ordinary thermo-electric battery, made from pairs of dissimilar metals, a very small proportion of the heat communicated to the joint is converted into electricity, which is, therefore, obtained from them at a great disadvantage. But, considering the comparatively great intensity of the currents produced when loose contacts are adopted, it seems possible that, by their means, a considerable part of the heat used may be absorbed in the production of electricity, which would, in that case, be more cheaply obtained from heat than directly from chemical action.

It is needless to allude to the consequences which would ensue should a cheap source of electricity be discovered; but without anticipating such important consequences from the discovery of the loose contact currents, they certainly seem a fit subject for further investigation, and, meanwhile, it is interesting to consider how, when two wires are tightly joined, the heat given them by the flame travels but a few inches slowly along them, producing all its sensible effects on objects in the immediate neighbourhood, whereas, when these wires are moved asunder to an almost imperceptible distance, that same heat may, in an instant, be flashed as electricity through thousands of miles, re-appearing distributed once more in the form of heat almost simultaneously in every part of the whole circuit.

NOTICES OF BOOKS.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

FOURTH NOTICE.

The process for the preservation of stone which bears a close comparison with the results of Mr. F. Ransome is that proposed by Mr. Barff and Dr. Sullivan. In the name of the former of these gentlemen a patent has been taken out for the application of the carbonates of zinc and lead, and also of alumina, in conjunction with the soluble alkaline silicates. The plan of treatment originally contemplated seems to have consisted in first applying a coating of white lead and then washing this over with a solution of silicate of soda: by this means a hard, durable coating is produced, not liable to efflorescence, but open to the objection that in the course of time the white lead compound would become discoloured by the action of sulphuretted hydrogen in the atmosphere. It was this consideration principally which induced Mr. Barff later to substitute the carbonate of zinc for the white lead; and for the special application to the Houses of Parliament it is proposed also to employ a small proportion of alumina in the first coating—this latter substance being used in the form of a powder, but from what source derived is not stated. The object served particularly by the addition of alumina to the other ingredients is that of enabling him to take advantage of the affinity which it is known to possess for potash or other alkaline base; on which account the transfer of silicic acid from the silicate is believed to be materially assisted. With respect to the subsequent treatment with silicate of potash the use of two or even three applications upon a single coating of the mixed carbonate of zinc and alumina is recommended; also in regard to the zinc itself, it appears that the oxide or ordinary white zinc paint will not answer the purpose, but we have no very definite information as to whether a powdered native variety of the carbonate of zinc, or an artificially prepared form of that substance, is intended to be employed.

The introduction of pigments to modify the colour of surfaces treated by this process is said to be practicable, and in some cases even desirable. In reference to this point the Committee seem to have directed their inquiries to the character of surface produced as the general result of the treatment,—whether, in fact, the coating presented an appearance at all similar to that of ordinary white lead or zinc paint applied direct to stone. We would remark that, so far as the scanty information afforded by Mr. Szerelmey in reference to his process will permit of any comparative conclusion being drawn, it appears probable that the suggestion of Mr. Barff and Dr. Sullivan nearly coincides, or, at least, has some points in common with the system of treatment adopted by Mr. Szerelmey in coating certain portions of the Palace at Westminster.

Under the head of silicates it will be proper to notice the suggestion of Mr. J. J. Griffiths, of Whitby. This refers to the use of an article known to architects under the name of Atkinson's cement. It is prepared from nodules occurring in the alum schists of Yorkshire, which, when properly burnt and ground, furnish an excellent hydraulic cement of very pale colour. In general pro-

perties it appears to resemble Portland cement. A quantity of the finely-ground material is to be stirred up in water and quickly applied as a thin wash to the face of the decaying stone. After a short interval the water will have been absorbed, entering into chemical union with the constituents of the cement, and thus, by filling the cavities and setting hard in the pores of the stone, is said to offer a considerable degree of protection, chiefly by keeping out rain and moisture. According to the circumstances, a second, or even third treatment, at intervals, will be required to secure the best results. This method of protecting stone has been applied by Mr. Griffiths with great success to the walls of houses in the neighbourhood of Whitby, which, from having been constructed of Yorkshire freestone, an open porous sandstone, allowed the water freely to penetrate in rainy seasons. By a single application of the cement, the stone has been enabled to resist for ten years and upwards the stormy weather which occasionally visits the eastern coast.

In questioning the applicability of a coating of Atkinson's cement to the Houses of Parliament, the Committee have raised doubts, firstly, in regard to its power of sufficiently penetrating the substance of the stone—whether the solid particles of cement would not be separated as by a filter, and form merely a superficial protective crust? and secondly, as to the appearance and texture of the stone after treatment—whether it would not look like stucco? For these reasons it does not appear to be equally well adapted to surfaces of decomposing magnesian limestone and to the coarse-grained, porous sandstones of Yorkshire.

NOTICES OF PATENTS.

437. *The Application of Certain Vegetable Substances to the Manufacture of Paper Pulp.* J. H. Johnson, Lincoln's Inn Fields, London. A communication. Dated February 21, 1861.

The vegetable productions which it is proposed to make use of in the preparation of pulp for paper making are the following—viz., the fir tree, pine, larch, and, in fact, all coniferæ, junipers, willows, and osiers, tamarinds, broom, and coparia; also the genus juncus, or rush and genista. Amongst herbaceous plants those of the mallow tribe and the bursaria, particularly the bursa pastoris and its varieties; the panicum Germanicum and the tall panicum lupinus, the sorghum, or millet; also those plants of the genus lepidium, or pepper wort, comprised under the order of cruciferæ; also the dead leaves of the haricot and pea, and of the thistle. The general treatment to which the above-mentioned vegetable productions are subjected consists, firstly, in boiling them in an alkaline liquor and in draining off this latter as soon as the structures are tolerably softened, then bruizing the same in any convenient machine for the purpose of separating the fibres, and afterwards carding, alternately subjecting the loosened fibres to the action of acid and alkaline baths to remove soluble matter and assist disintegration, washing and bleaching by the chloride of lime or any well known process, and finally pressing the pulp into cakes or compact masses easy of transport.

The general mode of treatment here described has during the last few months repeatedly formed the subject of patent claims. It is interesting to remark the identity of language employed in defining the various stages in the unalterable succession of operations which constitute the process for obtaining paper maker's pulp from wood and softer vegetable structures. We have recently had occasion to describe the following patents bearing on this subject:—Indian corn and tanner's refuse (the spent bark of oak or fir) have each been made to furnish ligneous fibre for the purpose of paper making. Specification No. 112, C. Stevens,[1] details the process of converting wood shavings, and even that of *fir*, into pulp by boiling with alkali, mechanical tearing, bleaching, &c. And the patent No. 391,[2] dated but five days earlier than that now before us, refers particularly to the method of treating alternately with acid and alkali as means of expediting the disintegration of the fibre in wood.

454. *Coating and Protecting the Silvered Surface of Looking-glasses or Mirrors.* J. E. Cook, Greenock. Dated February 22, 1861.

For the purpose of protecting the mercurial film of looking-glasses from the action of the atmosphere, it is proposed to coat the outer surface of the tin foil with copal or carriage varnish, laid on with a brush in the ordinary manner; the varnish may be used alone, or mixed with any suitable colour. When dry, a solution of shellac is applied as a second coating.

By the employment of alcohol as the solvent in the second varnish, there will be no fear of disturbing the layer of copal previously applied. Such a double coating would probably diminish the tendency to oxidation, but the mirror would, on the other hand, become more liable to mechanical injury from sudden changes of temperature inducing unequal rates of expansion and contraction in the three films, all in absolute contact with each other and with the back of the glass.

456. *Preparation of Red Dyes.* J. Martin, Church Row, Limehouse. Dated February 23, 1861. (Not proceeded with.)

The dyes which form the subject of this invention, are prepared from aniline by the action of nitrate of lead and monohydrated acetic acid. These are mixed together, heated, and subsequently diluted and filtered. For the extraction of the lead compounds from the product, the inventor employs oxalic or other organic acid, with the addition of common salt, which is said to heighten the brilliancy of the colour. Although the nitrate of lead is particularly specified, the inventor claims also the production of red dyes from aniline by the employment of other nitrates yielding oxygen on the application of heat.

A patent has some time previously been granted for the use of the nitrate of mercury as a means of effecting the conversion of aniline into red dye; this circumstance would invalidate the claim stated in the concluding part of the specification, which appears to have been drawn up in too general terms.

455. *Manufacture of Cast Steel.* Robert Mushet, Coleford. Dated February 22, 1861.

473. *Manufacture of Cast Steel.* Robert Mushet, Coleford. Dated February 23, 1861.

These inventions have reference to the production of superior qualities of cast steel by the employment of titaniferous iron ore, or other compounds of titanium, in conjunction with the materials ordinarily used in the preparation of cast steel. This admixture may be effected in two ways. Either the titaniferous ore above mentioned, or any native variety of titanic acid, may itself be introduced into the melting pot with the mixture of cast iron, granulated or refined pig iron, and pulverized iron ores, or any other form of oxides of iron and manganese with appropriate reducing agents. Or, secondly, the titanium ore may previously have been reduced by a suitable furnace treatment with deoxidizing agents, to the condition of an alloy of titanium and iron, and in this form added to the melted materials intended to be used in the production of cast steel.

[1] Chemical News, vol. iv., p. 134.

[2] Chemical News, vol. iv., p. 213.

With a similar object the latter of these patents refers to the employment of the special description of white cast iron termed "spiegel eisen," or of any analogous compound of iron, manganese, and carbon, and such material being alloyed by melting either with the titanium cast steel already described, or with any mixture of substances intended to be used in its production.

These specifications are in continuation of a number of similar patent claims already secured by Mr. Mushet, and which have on former occasions been noticed in our columns. They all refer particularly to the economical employment of the titaniferous iron sand, procurable in great abundance in New Zealand, which is now shown to be so advantageously used in the production of improved qualities of cast iron and steel.

Grants of Provisional Protection for Six Months.

1732. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the manufacture of fluo-silicates of lead and baryta, and for the application of the same to various purposes in the arts and manufactures."—Petition recorded July 8, 1861.

1734. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the treatment of silicates of metallic and non-metallic bases and other siliceous compounds, as slags, scoriæ, and such like, in order to recover the said bases, and also in the production of a fluo-silicic and silicic acids."—Petition recorded July 9, 1861.

1775. James Cane Coombe and James Wright, Bridge Street, Blackfriars, London, "Improvements in the manufacture of glass, pottery, porcelain, and other ceramic and plastic wares."—Petition recorded July 15, 1861.

2085. Andrew Stein, Edinburgh, Mid Lothian, N.B., "Improvements in distillation."—Petition recorded August 21, 1861.

2286. John Adams Knight, Symond's Inn, Chancery Lane, London, "An improved apparatus for rendering fatty or oleaginous matter, and delivering the same."—A communication from Wellington Lee, Esq., East 19th Street, New York, U.S.

2288. Richard Waller, Baker Street, Portman Square, London, "Improvements in machinery and apparatus for manufacturing and refining cane juice and other saccharine substances."

2326. Edward Alfred Cowper, Great George Street, Westminster, "Improvements in apparatus for freeing gases from dust and other particles of matter floating therein, and for causing vapours or gases to be absorbed by liquids."

2347. Rene Prudent Patrice Dagron, Paris, "An improved microscope to be used for exhibiting photographic views and productions."—Petitions recorded September 19, 1861.

2383. Charles Watt, Graham Street, Walworth, John Watt, Lorrimore Street, Walworth, Surrey, and Thomas Snaith Haviside, Cornhill, London, "An improved mode or method of bleaching palm oil."

2397. John Vaughan, Middlesborough, Yorkshire, "Improvements in treating gas produced by blast-furnaces in its passage from the blast-furnaces to other furnaces, stoves, boilers, or other heating apparatus where gas may be employed."—Petitions recorded September 25, 1861.

Notices to Proceed.

1291. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improvements in the coupling or connecting joints of pipes for the conveyance of liquid, fluid, or solid bodies."—A communication from J. B. Lavril, Paris.—Petition recorded May 21, 1861.

2032. John Cowderoy Martin, High Street, Barnes, Surrey, "An improvement in treating bones, and the manufacture of the products thereof."—Petition recorded August 15, 1861.

1322. Edward Henry Cradock Monckton, Parthenon Club, Regent Street, London, "Improvements in obtaining and applying magnetic motive power, which invention is also applicable to other useful purposes."—Petition recorded May 25, 1861.

1338. Robert Michael Letchford, Old Montague Street, London, "An improvement in the manufacture of matches."

1353. Alfred Blake, Russell Place, Fitzroy Square, London, "Improvements in the process of brewing."—Petitions recorded May 30, 1861.

1364. Ebenezer Hartnall, Ryde, Isle of Wight, "An improvement in the manufacture of paper."

1411. Edward Charles Stamford, Worthing, Sussex, "Improvements in obtaining products from seaweeds."—Petitions recorded June 4, 1861.

1789. Richard Jones, Camden Town, London, "Improvements in safety lamps."—Petition recorded July 16, 1861.

1983. James Hemingway, Robert Town, Yorkshire, "Improvements in machinery or apparatus for working coal, ironstone, or other minerals."

2268. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "An improved combination of chemical and mechanical processes for the conversion of fibrous vegetable matters into paper pulp."—A communication from Louis Achille Carteron, Dieuze, Meurthe.—Petitions recorded September 12, 1861.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Salts of Fluorine, Silicon, and Mercury.—Finkener describes (*Poggendorff's Annalen*, Bd. cxi. 248) three compounds of the above bodies. The *silico-mercurous fluoride* is obtained in clear prismatic crystals when a solution of carbonate of the protoxide of mercury in hydrofluosilicic acid is evaporated. Washed with a little water, then pressed between folds of bibulous paper, and afterwards dried over sulphuric acid, these crystals on analysis gave results from which the author calculated the following formula, taking the equivalent of silicium as 21:—

$$3Hg_2\,Fl,\ 2Si\,Fl_3 + 6HO.$$

Berzelius' *silico-mercuric fluoride* Finkener has found to be an hydrated *oxyfluoride*. It is obtained in small acicular crystals on evaporating a solution of mercuric oxide in hydrofluosilicic acid. The composition he found to be

$$3Hg\,Fl,\ 2Si\,Fl_3\ 3HgO + 9HO\ (Si = 21).$$

This salt is decomposed by water at the common temperature, forming an acid salt, which remains in solution, and depositing a yellow powder rich in oxide of mercury. The same solution concentrated until the needles begin to form, and then kept at a temperature never exceeding 15° C., deposit clear rhombohedral crystals, united like steps. These deliquesce in the air, and melt in their water of crystallization. Over sulphuric acid they effloresce. They are formed of the *silico-mercuric fluoride*, Hg Fl, Si Fl_2, and appear to contain six atoms of water.

Double Salts Formed by Iodide of Bismuth.—Lindau has obtained (*Poggendorff's Annalen*, Bd. cxi. s. 240) some double salts with iodide of bismuth, greatly resembling the double salts with iodide of antimony, described by Schaefer (Chemical News, vol. ii. p. 143). They are obtained by saturating a concentrated solution of the positive metals with iodide of bismuth, and evaporating the solutions.

Iodide of Bismuth and Sodium forms small red crystals, containing $3Na\,I,\ 2Bi\,I_3 + 24HO$, and apparently is amorphous, with the salt $3Na\,I,\ 2Sb\,I_3 + 24HO$.

Iodide of Bismuth and Ammonium forms beautiful rectangular prisms of a brownish red colour. The powder is vermilion red.

Iodide of Bismuth and Barium is obtained in small rhomboidal crystals of a bright red colour and brilliant lustre. The composition is $2\,BaI, BiI_3 + 18\,HO$.

Iodide of Bismuth and Calcium has a similar composition to the preceding salt. It forms rhomboidal prisms of a deep red colour and glassy lustre. The powder is carmine red, but nearly black when the water of crystallisation has been driven off.

Iodide of Bismuth and Magnesium ($MgI, BiI_3 + 12\,HO$) forms oblique rectangular prisms of a pomegranate red colour. The water of crystallisation cannot be got rid of under a temperature of 175° C.

Iodide of Bismuth and Zinc ($ZnI, BiI_3 + 12\,HO$) resembles the preceding, but loses its water at 100° C.

The author could not obtain salts with the iodide of bismuth and iodides of cadmium, iron, and silver. He succeeded in obtaining crystallised compounds with iodide of bismuth and bromides of potassium, sodium, ammonium, magnesia, and zinc, but has not yet examined these salts.

II. ORGANIC CHEMISTRY.

Modifications of Aldehyde.—Lieben (*Sitzungsb. der K. Akad. der Wissenschaften zu Wien*, Bd. li. s. 649) heated iodide of ethyl and aldehyde in a sealed tube to 100° C. The former remained unaltered, but the latter changed to an isomeric modification resembling paraldehyde. It boiled at 123° to 124°, and possessed a vapour density three times that of aldehyde.

Aldehyde, when well cooled, he found to absorb a considerable quantity of cyanogen. The solution, sealed up and left for some time at the ordinary temperature, formed paraldehyde, the cyanogen undergoing no change. When aldehyde is heated in a sealed tube with a strong aqueous solution of either formiate of potash, acetate of soda, or the potassio-tartrate of soda, two layers are formed: the lower is the unaltered solution of the salt used; the upper is a slightly viscid yellow liquid, having a penetrating odour. This liquid is very unstable, but, after rectifying with great care, the author determined that it was mainly constituted of a new body, having the composition expressed by the formula C_4H_6O. Exposed to the air, it thickens; it reduces oxide of silver, is resinified by potash, and blackens with sulphuric acid. Nitric acid acts on it violently, causing the evolution of much gas, and forming some resinous matter. Heated alone in sealed tube to above 200° C. it changes to a nearly solid black mass and a little water. It is formed, the author thinks, by the elimination of water under the influence of the salt: $2\,(C_2H_4O = C_4H_6O + H_2O)$. Aldehyde heated alone undergoes no change.

Lieben proposes the following rational formula for aldehyde which, he says, lends itself to the interpretation of all the reactions of that body:—

$$\left.\begin{matrix}(C_2H_3)'''\\ H\\ O''\end{matrix}\right\}$$

Paraldehyde and elaldehyde he believes (with Geuther and Cartmell) to be identical.

Diamylphosphoric Acid.—Dr. Kraut (*Archiv. der Pharm.* Bd. cxvi. s. 133) obtains this acid by acting on a solution of bromine in fusel oil with phosphorus until the colour disappears. The product is then washed with water to remove the hydrobromic acid, and the oily residue of bromamyl and diamylphosphoric acid is shaken up with a soda solution. The mixture is then boiled to get rid of the bromamyl, and the solution of diamylphosphate of soda is supersaturated with dilute sulphuric acid, whereupon the mixture becomes milky, and oily drops separate. These are taken up by ether; the ethereal solution is washed, evaporated, and dried over sulphuric acid. The acid is not obtained perfectly pure in this way, some substance remaining mixed with it, the exact nature of which is unknown to the author.

Dr. Kraut examined several salts of the acid. *Diamylphosphate of Lime* $2\,C_{10}H_{11}O + CaO\,PO_5$ was obtained by adding water and milk of lime to the above etherial solution of the acid. The excess of lime was removed by diluting with a good deal of cold water, passing carbonic acid through the mixture, boiling and filtering. The filtrate was evaporated over a water-bath. The salt forms long snow-white silky needles, which on being dried shrink up to a papery mass; this remains unchanged when heated to 180° C., and when rubbed becomes electrical. When dropped into water it rotates with great rapidity. It dissolves as easily in cold as in hot water, and is so soluble that the cold saturated solution solidifies when heated.

According to Fehling, the diamylphosphates of the alkalies precipitate the salts of manganese, lead, copper, silver, and mercurous oxide. The cold saturated solution of the lime salt separates only some flocculi from the manganese, copper and silver salts, but gives a large precipitate with the lead and mercury salts. The baryta salt is more soluble in cold than hot water. On heating a cold saturated solution of the magnesia salt, it separates in asbestos-like needles, which settle into a fat-like mass the instant they are removed from the mother liquor.

Diamylphosphoric acid forms an acid and a neutral silver salt. When shaken up with moist silver oxide, separated from the excess, and evaporated, microscopic needles of the acid salt are obtained. These dried over oil of vitriol remain unchanged at 120°, and have the composition $2\,C_{10}H_{11}O, AgO\,PO_5 + 2\,C_{10}H_{11}O, HO, PO_5$. The neutral salt is obtained by decomposing a solution of sulphate of silver in hot water with an equivalent weight of the baryta salt. It has the formula $2\,C_{10}H_{11}O, AgO, PO_5$.

When submitted to dry distillation, the salts of diamylphosphoric acid yield a clear liquid, and leave a residue of a metaphosphoric acid salt scarcely blackened by carbon.

MISCELLANEOUS.

Adulteration of Food.—The Cheltenham Board of Guardians have appointed Mr. Horsley, the County Analyst, at a salary of ten guineas per annum, to analyse the provisions supplied for consumption in the Union Workhouse.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the EDITOR; and *Advertisements* and *Business Communications* to the PUBLISHER at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

T. Falconer.—The solvents vary according to the mode of preparation. In some cases alcohol, in others dilute acetic acid, and in some few water will be found the best solvent.

D. Knight.—The best practical information with which we are acquainted on the subject of grinding lenses is in a pamphlet published by Secretan, of Paris, entitled, "De la Distance Focale des Systèmes Optiques convergents." It costs about 2s. 6d. to 3s.

Red Ink to be used with Steel Pens.—J. M.—We do not know a good receipt. Those which we have tried have not answered our expectations. The suggestion shall be attended to if possible.

W. B.—The crust formed on the leaden top of your inkstand is probably carbonate of lead, formed by the acid and aqueous vapours from the ink. As a remedy use India-rubber varnish, or deposit silver on it electro-chemically.

J. Horsley.—It is withdrawn as you request. Our examination of the sample sent coincides with yours. We shall be glad to receive the full statement promised.

W. Steevenson.—Received.

A. H B.—1. Allow it to digest in a mixture of alum, salt, and nitre, dissolved in water. 2. See our previous volumes. 3. The zinc plates need not be quite so large as the silver, but more than half the size.

A Subscriber.—Boil them with dilute hydrochloric acid and copper. Test the copper subsequently in the usual way. We do not think arsenic is present; it is scarcely ever used now for that purpose.

THE CHEMICAL NEWS.

VOL. IV. No. 100.—November 2, 1861.

THE PRESERVATION OF STONE.

IN another column will be found an abstract of the plan, which was submitted on 17th May last, by the Editor of this Journal, to the Committee on the Decay of the Stone at the New Palace at Westminster, with the view of hardening and preserving it from further decay. Since that period we have unremittingly pursued our experiments on the subject, both with the plan above referred to, and various others, which were suggested by reactions incidentally noticed in the course of the investigation, and it is to one of these offshoots of our experiments that we wish now to draw attention.

No one who has critically examined the various projects for hardening and protecting stone, which have during the last few years been made public, can have failed to remark the great importance, which, in the majority of instances, is attached to the action of silica. Thus, in reviewing the processes submitted to the Decay of Stone Committee, among the eleven proposals which have already been under consideration, no less than seven depend for their efficacy upon the action of this very substance under various conditions of employment. Advantage is taken of the mutual decomposition exerted between certain silicious compounds applied, and the materials constituting the building stone itself; or, otherwise, systems are founded upon the production of compounds from an alkaline silicate, and a soluble earthy salt successively applied. The known properties of silica and of the class of silicates have, no doubt, powerfully contributed to the formation and establishment of this opinion. The facility and cheapness with which they can be manufactured on the large scale; their inalterability under trying atmospheric influences; their all but complete indifference to energetic chemical reagents—all point to silica as the one fit material upon which the ingenuity and experimental resources of our chemists and practical men may be expended with the greatest promise of success. Let only a sufficient amount of silica be compelled to enter and occupy the pores of the stone and incrust all the exposed surfaces; let it be employed in a state of hydration or other suitable form in which it may gradually combine with the earthy constituents it there meets, and with its action unfettered by saline impurities the presence of which tend often to interfere mechanically with its successful employment, and the strong presumption is that the Houses of Parliament will endure, so far as the stone is concerned, as long as the Pyramids.

The difficulty which besets many of the processes of silicification is, that along with the needful silica, so much superfluous, and, indeed, injurious matter is introduced that the valuable qualities of the silica are in a great measure counteracted; the disintegration of the stone sometimes caused actually by the efflorescence of these extraneous substances, and the porous character necessarily induced as the consequence of the gradual removal of the soluble salts in juxtaposition with the silica, almost undoing the binding and hardening action of this valuable material. From this train of reasoning, it became evident that if hydrated silica could but be deposited in the pores of a limestone or dolomite, without the assistance of potash or soda as a vehicle, and there be left slowly to enter into chemical union with the earthy bases of the stone, its action commencing unimpaired by the presence of extraneous salts, and its future efficacy undiminished by the progress of their removal,—that if this could be accomplished, there would be a far greater chance of ultimate success than has been offered by any plan yet made public.

It is well known that silica can, by appropriate means, be obtained in the form of a pure aqueous solution, and it was to this liquid that we accordingly directed our attention. This solution can be made in several ways:—

1. By dissolving sulphide of silicium in water, when sulphuretted hydrogen is given off, and the silica remains completely dissolved, and in such quantity that the liquid gelatinises when an attempt is made to evaporate it.

2. By precipitating silica in the gelatinous state from an alkaline silicate, by means of acetic or other weak acid, and, after well washing, heating it for some time under pressure, with a small quantity of water in a closed vessel. A liquid is thus obtained which gelatinises on addition of a saline solution.

3. By passing gaseous fluoride of silicium over crystallised boracic acid, and separating the hydrofluoric and boracic acids by digestion with a large excess of ammonia, a hydrate of silica remains, which, when well washed from the above acids, is very soluble in water. This solution gives no precipitate when boiled, but leaves silica as an insoluble powder on evaporation.

4. By the beautiful method recently pointed out by Professor Graham, in which advantage is taken of the new means of separating bodies by *dialysis*. A solution of silicate of soda, supersaturated with hydrochloric acid, is placed on one side of a parchment paper septum, pure water being on the other side; in a few days the hydrochloric acid and chloride of sodium will be found to have completely passed through the diaphragm, leaving the silica in aqueous solution, and so pure that acid nitrate of silver fails to detect chlorine in the liquid. This solution remains fluid for some days, but it ultimately gelatinises. We have generally adopted this last plan of preparing the aqueous solution of silica, although a stronger solution is obtained by the method first given.

When a pure aqueous solution of silicic acid prepared as above is allowed to soak into the pores of chalk or dolomite, a process of hardening rapidly occurs, which goes on increasing for several days, whilst, owing to its considerable depth of penetration, and to there being no soluble or efflorescent compounds to be removed, there is every probability that this hard silicious impregnation will afford permanent protection to the stone. We are now actively engaged in investigating the nature of the action which takes place, and already several curious and important results have been made out, from which we are led to anticipate that our experiments will ultimately be rewarded with complete success.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, Member of the Royal Academy of Belgium.

(*Continued from page* 218.)

Synthesis of Chloride of Silver.—I have determined the proportional relation between silver and chlorine,—

1st. By the direct combustion of the metal in chlorine, as has already been performed by M. Dumas.

2ndly. By dissolving silver in nitric acid, precipitating the nitrate by means of gaseous hydrochloric acid conducted to near the surface of the solution; evaporating the whole to dryness in the same vessel, and fusing the resulting chloride in an atmosphere of hydrochloric acid gas, afterwards replaced by air.

3rdly. By dissolving silver in nitric acid, precipitating by aqueous hydrochloric acid, washing the precipitate in water acidulated with nitric acid, fusing the chloride in an atmosphere of hydrochloric acid, and evaporating all the liquids out of contact of air, to collect the chloride carried down or dissolved by them.

4thly. By dissolving silver in nitric acid, precipitating the nitrate by a solution of pure sal-ammoniac, washing the chloride in acidulated water, and fusing it in an atmosphere of hydrochloric acid; then evaporating out of contact of air all the washing waters (after having passed through them a current of chlorine to destroy the nitrate of ammonia formed and the excess of sal-ammoniac employed), to collect the chloride carried down or dissolved.

These methods, which, however, have already been employed, have all given the composition generally admitted for chloride of silver; they present causes of error which I shall point out when detailing the results given by each.

I. Synthesis of Chloride of Silver by the Action of Chlorine on Silver heated to Redness.—To effect the combustion of silver in chlorine, I have taken a tube of Bohemian glass, bent in such a manner that the silver in lumps or sheet was contained in a portion very slightly inclined, so that the chloride as it was formed should be carried by the chlorine into a horizontal portion, which served as a receiver. This horizontal portion was bent upwards again very slightly to avoid loss of chloride. The tube and the silver were weighed separately. All that part of the tube which was to be heated was surrounded with a thin sheet-iron case, filled with pure magnesia. This case was not heated to redness until the pure dry chlorine which traversed the tube had been passing sufficiently long to completely drive out all the oxygen.

The complete chloruration of 100 grammes requires a slow and uninterrupted current of chlorine for at least fifteen hours. It is likewise necessary to take the greatest precaution to prevent any trace of silver escaping the action of the chlorine. Thus, out of five experiments that I made, two were vitiated owing to particles of silver being surrounded with fused chloride, and thus remaining unattacked.

The synthesis of chloride of silver by this method is liable to three sources of error or uncertainty. The first is the mechanical carrying away of the chloride of silver by the current of chlorine. Having found this out in the first experiment, I tried to obviate the inconvenience by allowing no more chlorine to pass over the silver than it would absorb. I cannot describe without a drawing the arrangement of apparatus which I devised for this purpose; I give it in my memoir.

The second inconvenience is the absorbent power which the fused chloride has for chlorine. To obviate this source of error, I caused to pass in one experiment a current of air, and in two others a current of dry carbonic acid over the fused chloride, but after having previously noted the weight of the chloride.

Finally, the third source of error is the attack of the glass tube by chloride of silver, which is kept long fused in contact with it. There is thus produced an alkaline chloride, which volatilises in the current of chlorine. I am not quite certain whether this attack takes place with disengagement of oxygen or chlorine, but the augmentation of the weight of the tube is a constant fact.

To sum up, this method, which at first sight appeared so simple, leaves grave doubts as to its results, if these are not confirmed by those obtained by means of other methods.

Below is given the result of three experiments which I succeeded in bringing to a satisfactory conclusion:—

Synthesis of Chloride of Silver by the Combustion of Silver in Dry Chlorine.

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight in air of the Chloride of Silver fused in chlorine.	Weight *in vacuo* of the Chloride of Silver fused in chlorine.	Weight in air of the Chloride of Silver fused in a slow current of carbonic acid.	Weight *in vacuo* of the Chloride of Silver, after eliminating the dissolved chlorine.	100·000 parts of Silver produce	
							A.—Chloride saturated with chlorine.	B.—Chloride freed from dissolved chlorine.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.		
I.	91·4655	91·462	121·497	121·5058	121·4905	121·4995	132·848	132·841
II.	69·870	69·86735	92·820	92·8273	92·8075	92·8145	132·861	132·843
III.	101·523	101·519	134·867	134·877	134·851	134·861	132·859	132·843

II. Synthesis of Chloride of Silver, by dissolving Silver in Nitric Acid, precipitating the Nitrate by means of Gaseous Hydrochloric Acid conducted to near the Surface of the Solution, evaporating the whole to Dryness in the same vessel, and fusing the resulting Chloride in an Atmosphere of Hydrochloric Acid Gas, afterwards replaced by a Current of Air.—Almost all my syntheses of chloride, and nitrate of silver and lead, have been made in the same apparatus. A drawing of this is given in my memoir. I will here describe it in a few words. The apparatus consists of a globe or matrass of Bohemian glass of a convenient size, according to the quantity of the metal to be dissolved, to the neck of which is adapted a flask of the same glass, the bottom of which is removed. To the narrow opening of this flask I adjust hermetically a system of bulb tubes, which serve to wash the gas traversing them, so as to retain the nitrate carried away by the nitrous vapours during the solution of the metal. The bulb-tube has a vertical branch leading into a small globe of water. The last trace of metal is thus arrested.

In order to attach the globe conveniently to the balance, I have arranged a system of platinum wires by which to hang it; these during the experiment do not come in contact with acids.

The globe, with the flask attached to it, being weighed, and the weight verified the next day,—a precaution which I have taken in all my syntheses,—I introduce into it the silver in small bars, and then pour in the nitric acid which has immediately before been distilled. Holding the neck of the globe almost horizontal, I adapt to it the flask with the tube, containing in its bulbs a convenient quantity of pure water, and fix the whole in this position. The globe is then carefully heated in an air bath. During the solution of the metal, I take care that the temperature never rises above 50° or 60°, otherwise the action is too energetic, and in spite of all precautions silver is carried through the condensing apparatus. Three or four hundred grammes of silver require at least thirty-six or forty-eight hours' action to dissolve in nitric acid of a strength of 40°, or even 25°, Baumé.

When the solution is complete, I remove the bulb-tube and the flask from the globe, taking care always to keep this in its original position—that is to say, with the neck almost horizontal. I then pass into it a slow current of hydrochloric acid, continuing the current until the liquid, set in motion by the rotation of the globe, becomes turbid. I then insert the neck of the globe as far as possible into the mouth of the receiver, and gently incline the whole of the apparatus, so that the vapour which condenses in the neck cannot run back. I heat the liquid in the globe by means of an air-bath to a temperature which approaches, but which must never reach, its point of ebullition. When almost all the liquid is volatilised, I again pass hydrochloric acid gas into the globe without allowing it to cool, and always keeping it in the inclined position. Dark red vapours are immediately formed, which soon give place to pure gaseous hydrochloric acid. I then evaporate it completely to dryness, and heat the chloride to its fusing point.

I have sometimes weighed the chloride dried at its fusing point, in order to ascertain the quantity of nitrate of silver which it retains when it is precipitated from a concentrated solution of this salt. This quantity is very variable, but its presence is a constant occurrence. In order to obviate the augmentation of weight which it causes, I filled the globe with hydrochloric acid, and kept the chloride in a state of fusion as long as orange-yellow vapours appeared; but taking the precaution not to raise the temperature beyond the fusing point, for fear of attacking the glass and decomposing the chloride itself. I then replaced, with the aid of heat, the atmosphere of hydrochloric acid by one of dry air.

From the moment of its formation until after weighing the chloride of silver was completely kept from the action of light; thus, in these experiments the chloride of silver remained of a pearly white. The globe has been but rarely attacked; at the most there were to be noticed here and there some yellowish-brown spots on the glass. When the operation is terminated, the globe is fitted with the flask, which serves as a stopper for it. In order to prevent moisture from penetrating during its cooling, I adapt a chloride of calcium tube to the flask. When it is quite cool I wash the globe with water, and, after having wiped it dry, I suspend it to the beam of the balance and allow it to remain at rest for several hours.

The acid liquid which volatilises has always been evaporated a second time in a porcelain dish to see if silver be present in the residue, which I have always found. When reduced to a twentieth of its volume, I have added to it the contents as well as the rinsings of the bulb-tube and the flask through which the gas evolved during the solution of the silver was passed; the chloride obtained in this manner was weighed separately.

Two causes of error can affect the result, but they act in an opposite manner. One of them tends to increase the weight from impurity in the acids, or from the vessels being attacked. I have sufficiently explained in the introduction how I have removed this cause of error; I think I may safely say it does not exist. It is probable, on the contrary, that there is a slight loss of weight owing to the chloride of silver being carried away by the chloro-nitrous vapours which are produced during the fusion of this body in an atmosphere of hydrochloric acid to remove the nitrate of silver, whether this nitrate exists already in the precipitate formed in a concentrated solution of silver in nitric acid, or whether it has been formed by the direct action of the nitric acid on the chloride during the evaporation of the liquid acid.

Below I give the results of two experiments made by this method:—

Syntheses of Chloride of Silver.

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum	Weight of the Chloride of silver obtained from the silver carried off during the solution of the metal and the evaporation of the liquids.	Weight in air of the Chloride of Silver fused in hydro-chloric acid gas.	Total weight of the Chloride of Silver reduced to a vacuum.	100·000 parts of Silver produce of Chloride of Silver
	grmms.	grmms.	grammes.	grammes.	grammes.	
IV.	103·553	103·549	0·0345	144·162	144·207	132·849
V.	399·667	399·651	0·0940	530·787	530·920	132·846

III. Synthesis of Chloride of Silver by dissolving Silver in Nitric Acid, precipitating the Solution with a slight Excess of Hydrochloric Acid, washing the Precipitate, fusing the Chloride in Hydrochloric Acid Gas, and evaporating all the Liquids out of contact of air to recover the Chloride carried down or dissolved.—The solution of the silver was effected in an apparatus identical with the one previously described. The contents of the bulb-tube and the flask employed to condense the nitrate carried off by the gas, as well as the washing-waters of these two apparatus, were added to the contents of the globe. After complete cooling of the liquid, I carried the globe into a dark room, introduced a slight excess of hydrochloric acid, and shook the resulting chloride for at least twenty minutes to divide it, and to transform as completely as possible all the nitrate into chloride. At the end of that time the contents of the globe were heated to 100°. By the action of heat, the liquid became perfectly clear and the chloride had greatly contracted. The next day I decanted the liquid, with the greatest precautions. The globe, still remaining inclined, was then heated in a bath to 100°; there thus run from the chloride a fresh quantity of very clear liquid. I then poured into the globe, boiling water, very slightly acidulated with nitric acid; the chloride was then agitated to divide it afresh. The next day the liquid, which had become clear, was again decanted. The globe being placed in a very inclined position, was heated, and all the liquid produced by the contraction of the chloride under the influence of heat was decanted and added to the preceding waters. The chloride was thoroughly dried, then fused in an atmosphere of hydrochloric acid, which, as soon as fusion commenced, instantly eliminated chloro-nitrous vapours. The atmosphere of hydro-

chloric acid was then replaced by pure dry air. The chloride obtained was pearly white.

All the decanted solutions and the liquids obtained by drying the chloride were evaporated. In the experiment which I made in this manner on 99·9925 grammes of silver, the total volume of these liquids amounted to 2510 cubic centimètres When evaporated they left a residue the total weight of which was 0·0063 grammes, containing 0·0035 grammes of chloride of silver, the rest being composed of traces of chloride of copper and of alkaline and earthy chlorides.

This experiment gave the following results:—

Synthesis of Chloride of Silver.

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the Chloride of Silver obtained from the evaporation of the washing waters.	Weight in air of the Chloride of Silver fused in hydrochloric acid gas.	Total weight of the Chloride of Silver reduced to a vacuum.	100·000 parts of Silver produce of Chloride of Silver
VI.	grmms. 99·9965	grammes. 99·9925	grammes. 0·0035	grammes. 132·825	grammes. 132·8382	132·848

IV. Synthesis of Chloride of Silver by dissolving the Metal in Nitric Acid, precipitating the Solution with Chloride of Ammonium, washing the Precipitate, and fusing the Chloride in Hydrochloric Acid Gas.—This determination was made under absolutely the same conditions as the preceding, with this exception, that the hydrochloric acid was replaced by sal-ammoniac, and that the washing-waters and that derived from the drying of the chloride, before being evaporated, were submitted to a current of chlorine to destroy the excess of sal-ammoniac and of the nitrate of ammonia which was formed. The evaporation of these left me an appreciable quantity of chloride.

A synthesis made in this way with silver prepared from the acetate gave me the following result:—

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum	Weight of the Chloride of Silver derived from the metal carried down and dissolved by the washing waters.	Total weight of the Chloride in air.	Weight of the Chloride reduced to a vacuum.	Chloride of Silver produced by 100·000 parts of this metal
VII.	grmms. 98·3175	grmms. 98·3140	grammes. 0·0360	grammes. 130·5925	grammes. 130·602	132·8417

Thus, my syntheses of chloride of silver have given the following results:—

1. By the combustion of silver in chlorine	100·000 parts of silver.	I. 132·841 II. 132·843 III. 132·843
2. By the precipitation of silver with hydrochloric acid without washing the chloride		IV. 132·849
3. By the precipitation of silver with hydrochloric acid with washing the chloride		V. 132·846
4. By the precipitation of silver with sal ammoniac and washing the chloride		VI. 132·848
		VII. 132·8417
		Mean.. 132·8445

Since the sixth determination, in which an increase of weight is impossible, has given from 100·000 parts silver 132·848 parts of chloride, I consider the mean of 132·8445 as being above the truth; and I think we ought to admit that, within the limits of experiment, 100·000 parts of silver produce 132·850 parts of chloride. Hence it results that the proportion which silver bears to chlorine is in the ratio of 100·000 : 32·850.

(To be continued.)

On the Adulteration of Butter, by John Horsley, *Analyst to the County of Gloucester.*

A short time since the question was put by one of your correspondents as to whether there was any method of detecting lard in butter, which I have much pleasure in answering.

In order to distinguish between pure butter and that adulterated with lard and other substances, proceed thus:—

First satisfy yourself, by melting a portion of the suspected butter over a water-bath, and observing if there be any insoluble admixture of farinaceous matter, such as wheat-flour, potato-starch, arrow-root, or turmeric (said to be sometimes used), which the microscope and chemical tests will prove; then mix the melted butter in an evaporating-dish with four or five times its bulk of hot water, and allow it to stand for two or three hours to collect on the surface and solidify. Detach the resulting cake of butter, and place it on a piece of blotting-paper to dry, by the absorption of all adhering aqueous matter. If a piece of this prepared butter be introduced into a wide-mouth stoppered bottle, and surrounded with ether, at the temperature of 65° Faht., it ought to entirely dissolve, forming a clear lemon-yellow coloured liquid.

On the other hand, the purest lard, which, on being melted, leaves no residue, is more or less insoluble in ether at that temperature, as a thick milky fluid results, which, on standing, deposits to a considerable extent. The same may be said of other fats, such as dripping, mutton suet, tallow, &c., the precipitates from which are of a much coarser and flocculent character than that from lard in ether. Hence we perceive there is a striking peculiarity about butter, which, if treated as above, enables us to readily determine its purity and the probable proportion of foreign fatty matters mixed with it. The solution of lard and other fats in ether is considerably influenced by temperature, for if the bottle containing them be held in the hand a short time liquefaction takes place, but on a reduction of temperature they are again precipitated. The character also of the various precipitates is remarkable, and gives us some clue to their nature,—the precipitate from lard being very fine and smooth, whilst that of dripping is granular and crystalline, and that from tallow long and thread-like, laying piled up one above the other. A solution of butter in ether, exposed to a less temperature than stated, yields beautiful stellar-like tufts of very fine acicular crystals.

The Laboratory, Police Station, Cheltenham.

On the Effects of Reducing Agents upon Nitrate of Ethyl, by M. Carey Lea.

As ammonia under the influence of oxydizing agents is burned to nitrous and nitric acids, so these acids when acted upon by reducing agents, might naturally produce ammonia, or in the presence of a decomposing ethyl compound, might give rise to the formation of substituted ammonias. The experiment, however, seems to prove that while ammonia is a constant result of this reduction, it varies greatly in quantity according to the particular

reducing agent employed, and that substituted ammonias are not produced, at least not in recognisable quantities. The following were the reactions observed:—

Reduction by Protochloride of Tin.—Alcoholic solution of protochloride of tin added to nitrate of ethyl causes violent effervescence, but no disengagement of nitrous fumes. The solution of protochloride was added until reaction ceased. The whole was then distilled with caustic potash and the resulting gases conducted into dilute chlorhydric acid, which by evaporation left only a film of substance—this gave, on examination, distinct indications of ammonia.

Reduction by Sulphydric Acid.—A large quantity of sulphydric acid was conducted through nitrite of ethyl. Slight effervescence was produced and much sulphur deposited. The liquid filtered from the sulphur proved to contain a large quantity of ammonia, but no ethylamine, di-, or tri-ethylamine, although the mode of examination employed would have detected a very small quantity if present. After the removal of the ammonia, the solution heated with $PtCl_2$ gave a small quantity of a brown precipitate of a platinum salt, which when heated glowed for a long time, showing the presence of much carbon, and finally left a residue of reduced platinum. The amount obtained was too small for investigation, but 20 or 25 milligrammes of Pt salt were obtained from the decomposition products of 50 grammes of nitrite of ethyl.

This result, therefore, as far as the production of ammonia corresponds with that obtained by M. Emile Kopp,[1] although, as that chemist employed sulphydrate of ammonia instead of sulphydric acid, it does not appear that the production of ammonia by the reaction itself, could be positively established.

Reduction by Ferrous Acetate.—Nitrite of ethyl was added to about three times its bulk of ordinary acetic acid, and sufficient alcohol to make them mix. To this mixture iron filings were added. A powerful action set in without aid of heat. Deutoxyde of nitrogen was evolved in considerable quantity. When action had ceased, the resulting liquid was filtered, evaporated with chlorhydric acid and distilled with caustic potash. The distillate contained only traces of ammonia.

The effect of the reducing agents on nitrite of ethyl is therefore very different. Only with sulphydric acid was any considerable quantity of ammonia produced, and only with ferrous acetate was deutoxyde of nitrogen evolved.—*American Journal of Science*, No. 95.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. Mulder, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page 206.*)

In order to enable us to survey the whole phenomenon, we must start from this point of neutrality, leaving aside for the present the question whether this is precisely the point of true chemical neutrality.

In the liquid brought to the point of neutrality, solution of silver and salt produce a precipitate which is of the same strength in each case, the precipitate produced by silver taking, however, a longer time ere it makes its appearance.[1] The liquid, therefore, which is precipitable in this way, by means of solution of salt and silver, undeniably contains nitrate of silver and chloride of sodium at the same time; for if the clear liquid which we say has reached the point of neutrality—*i. e.*, in the first given instance after addition of ten, and in the latter instance after addition of thirty drops of the decimal solution of silver—did not contain silver in solution, chloride of sodium would not yield a precipitate of chloride of silver; and if, on the other hand, chloride of sodium were not present, nitrate of silver, on being added, could not give rise to a precipitate.

The clear liquid, therefore, brought to the so-called neutral point, contains nitrate of silver and chloride of sodium together in solution, combined in a peculiar manner, but not so intimately that the proper chemical affinity is quite suspended; for we find that if the clear liquid be divided into two equal portions, the addition of chloride of sodium to the one-half produces a precipitate of chloride of silver, while addition of solution of nitrate of silver produces a precipitate of chloride of silver, subtracting the chlorine from the chloride of sodium. The following table will illustrate this point:—

	I. The one half of the liquid brought to the point of neutrality.	II. The other half of the liquid brought to the point of neutrality.
Contains . .	NO_5AgO, ClNa, NO_5NaO	NO_5AgO, ClNa, NO_5NaO
Added to it .	ClNa	NO_5AgO
Produces insoluble	ClAg	ClAg
Retains in solution	ClNa, NO_5NaO	NO_5AgO, NO_5NaO

Although we have not entered into anything very strange, it will be as well to discuss more explicitly the simultaneous existence of NO_5AgO and ClNa. Let us return again to the experiment with three grammes of silver. Let us suppose that we have obtained the whole of the solution clear, after addition of thirty drops of solution of silver and subsequent shaking and settling of the precipitate, and, further, that we have divided the solution into two equal parts. Now, it is asked, what quantity of decimal solution of salt and decimal solution of silver can each portion of liquid bear in order to reach the limit of precipitability. It is difficult to solve this question by experiment, but from all that has been mentioned already, the answer to this question cannot be deemed a difficult one; for in order to reach the ultimate limit of precipitate, in the one half of the liquid of the solution of one gramme of silver, there will be wanted five drops of the decimal solution of salt, while in the other half of the same solution five drops of decimal solution of silver will be wanted. In the case, however, where three grammes of silver have been dissolved, the one half of that solution will require

[1] Gerhardt, *Chimie Org.*, ii. 347.

[1] It is worthy of notice that the colour of the precipitate produced by the addition of nitrate of silver to solution of salt is slightly grayish; while, on the other hand, the precipitate produced by chloride of sodium in solution of silver has a perfectly white colour, the same may be observed when the experiments alluded to are made,—viz., the mutual precipitation. The precipitate in both cases is of different physical quality—only when formed in so greatly-diluted solutions as are here spoken of—from the ordinary precipitate of chloride of silver. This difference in the appearance of the precipitate is not merely due to the greater state of division owing to its formation in a very much diluted solution; but invariably the precipitate will be found characteristic and different from what it normally is as soon as one has reached that limit where a precipitate ceases to be formed, even when that limit is cautiously sought for while using the standard solutions one cannot fail to find this to be the case.—M.

fifteen drops of the decimal solution of salt, the other half fifteen drops of the decimal solution of silver.

In order to reach the limits of mutual precipitation, one gramme of silver dissolved required 20 drops; half of this is neutralised by 10 drops. If the last 20 drops added were solution of salt, then the 10 required will be silver. If the whole mass of liquid be divided into two equal parts, in the one-half 5 drops of salt, and in the other half 5 drops of silver solution will find material for precipitation. When we had to do with the solution of 3 grammes of silver, we first required 60 drops, which were neutralised by 30 drops of the reagent, and the mass of liquid being divided into two equal parts, 15 drops of decimal solution of salt, added to the half portion, and 15 drops of decimal solution of silver to the other half, will find material for precipitation in each of the glasses which contain the liquids just alluded to.

It may, perhaps, not be out of place to elucidate these matters by bringing them in the shape of a table, as follows:—

	1 gramme of Silver	3 grammes of Silver
	Require [after having been precipitated by solution of salt to the ultimate limit, temperature being from 15° to 17° C.] cubic centimètres of decimal solutions.	
	c. c.	c. c.
In order to be carried to the ultimate limit of the precipitate of silver, solution of nitrate of silver	1	3
In order to reach the point of neutrality, requires addition of solution of common salt . .	0·5	1·5
If the mass of liquid is now equally divided into two test glasses, each glass will exactly take of solution of nitrate of silver and of solution of common salt .	0·25	0·75

I now return to what I have called mutual precipitation. In case the explanation given of what exists in the liquid when the point of neutrality[2] has been reached is correct, then it will not be difficult to explain how it is possible that—when one commences, for instance, from the ultimate point reached in making a silver assay, viz., after addition of solution of salt precisely in the quantity necessary for precipitation,—decimal solutions of silver and salt may be added, *vice versa*, until the limit of precipitability shall have been reached, and then back again, even an unlimited number of times, provided the chloride of silver does not change its colour.

In order to give this explanation in full, I will start from that moment when, in making the experiment, one has reached, on addition of decimal solution of salt, the limit of a visible precipitate. The liquid under experiment then contains what is mentioned in Table 1, viz., ClNa, NO_5NaO. And this being so, decimal solution of silver will yield a precipitate of chloride of silver. Let us take up the experiment again where we have 3 grammes of silver solution temperature 15° to 17° C., and let us add decimal solution of nitrate of silver, drop by drop, until 30 drops shall have been added, then there exists in that liquid what will be indicated below at A, while if we go on adding decimal solution of nitrate of silver, so that we pass over the neutral point (and this will happen with from 31 to 60 drops), there will take place in the liquid what will be found below in Table B.

A.—From 1 to 30 drops of nitrate of silver,—

The liquid contains . . .	Cl Na NO_5 NaO
Added	NO_5 AgO
Produces insoluble . . .	Cl Ag
There remains in solution	NO_5 AgO Cl Na NO_5 NaO

Neutral Point.

B.—From 31 to 60 drops of nitrate of silver,—

The liquid contains . . .	NO_5 AgO Cl Na NO_5 NaO
Added	NO_5 AgO
Produces insoluble . . .	Cl Ag
There remains in solution	NO_5 AgO NO_5 NaO

Between A and B is the place of the neutral point, at which nitrate of silver, as well as chloride of sodium, yield an equally strong precipitate.

I will now give a sketch of what will exist after B shall have been treated with 60 drops of decimal solution of salt (solution of 3 grammes of pure silver, temperature 15° to 17° C.), when one requires the ultimate limit of precipitability:—

C.—From 1 to 30 drops of solution of salt,—

The liquid contains . . .	NO_5 AgO NO_5 NaO
Added	Cl Na
Produces insoluble . . .	Cl Ag
There remains in solution	NO_5 AgO Cl Na NO_5 NaO

Neutral Point.

D.—From 31 to 60 drops of solution of salt,—

The liquid contains . . .	NO_5 AgO Cl Na NO_5 NaO
Added	Cl Na
Produces insoluble . . .	Cl Ag
There remains in solution	Cl Na NO_5 NaO

I hope I have herewith proved the *de facto* existence of mutual precipitation, and that this matter will be pretty clear now.

The following scheme may suffice for elucidation:—When the ultimate limit has been reached, the liquid, provided nothing more be added, contains dissolved:—

For Salt.	For Silver.
Cl Na	NO_5 AgO
NO_5 NaO	NO_5 NaO.

Whence it is evident that in the first case, where silver meets common salt, it will yield a precipitate; while, on the other hand, chloride of sodium meeting with silver will produce a precipitate. From the facts just alluded to, it is quite evident, that he who makes an assay by adding solution of salt as long as a perceptible precipitate is produced, adds more salt than will be required for the silver according to equivalent proportions.

In case this were not true, the whole explanation given would be incorrect; and that explanation is no hypothesis, but the simple expression of facts.

(To be continued.)

[2] Point of neutrality means that where decimal solution of silver and decimal solution of salt yield an equally strong precipitate.

TECHNICAL CHEMISTRY.

Description of a Gas Furnace for General Chemical Use, by John Joseph Griffin, *F.C.S.*

I have already published descriptions of several gas furnaces, adapted to special purposes.[1] The present notice refers to a simple form of gas-burner, which, aided by suitable fittings, can be used as a convenient source of heat for most operations of the chemical laboratory and lecture table. It will boil a quantity of liquid, exceeding two gallons at once; it will raise a $4\frac{3}{4}$ inch fire-clay crucible to full redness; it will fuse anhydrous carbonate of soda in greater quantity than is required for the analysis of a siliceous mineral; and it will melt small quantities of sterling silver. This amount of power is sufficient for most chemical operations that are not metallurgic.

The Gas Burner.—Fig. 1 represents the gas-burner of this apparatus. The gas is supplied by the horizontal tube, whence it passes through a set of small holes into the box *a*, in which it mixes with atmospheric air that enters freely by the holes shown in the sketch. The gaseous mixture passes up the vertical tube *b*, and is inflamed at the top, where it burns with a single, tall, blue flame, which gives no smoke, very little light, but much heat. In this condition, the apparatus differs from "Bunsen's Gas-burner" only in size. *c*, represents a thin brass cap, which fits the air-box *a*, but moves easily round it. *d* is a flat, cast-iron box, with many holes round the margin, and a few small ones on the top. This box fits loosely on the upper part of the tube *b*, and when it is placed upon it, and the gas is lighted, the flame produced consists of a series of radiating jets, forming a horizontal circular flame of about 7 inches in diameter. Fig. 2.—*a* shows a ring of horizontal flames thus produced, and *b* shows the single vertical flame.[2] The ring of flame is suited to the purposes of boiling and evaporation; the single flame to ignition and fusion. The height of the apparatus represented by Fig. 1 is 12 inches; the bore of the tube *b* is 1 inch; and the diameter of the fire-box *d* is 4 inches.

Fig. 1.

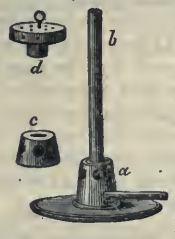
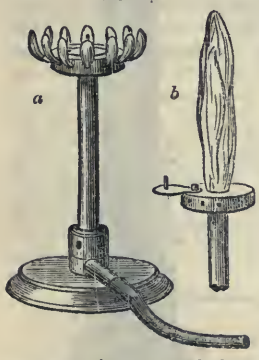


Fig. 2.



Bunsen's gas-burner, whatever its size, is subject to two defects: sometimes the flame burns white and smoky, and sometimes it blows down, the gaseous mixture explodes, and the gas then burns with a smoky flame in the air-box *a*, Fig. 1. The remedies for these defects are as follows:—If the flame is white only when the gas is turned on very full, the remedy is to lessen the supply of gas; but if the flame continues to burn white at the top when the gas is gradually turned off, and the mass of flame slowly sinks, then the holes which deliver the gas from the supply pipe into the air-box are too large, and are placed too directly under the centre of the vertical tube *b*, Fig. 1, and these defects must be corrected in the instrument. Finally, when the flame blows down, it is because the supply of atmospheric air is too large in proportion to the supply of gas, and their relative proportions must be altered. To effect this alteration, the cap *c* is to be turned round on the air-box *a*, so as partially to close the holes, and thus lessen the supply of air. If, when the gas is alight, the flame needs to be lowered, first the supply of air is to be lessened, and then the supply of gas. If the flame is to be enlarged, first the supply of gas must be increased, and then the supply of air. In short, to prevent the flame blowing down, the gas must always be first placed in excess, and then have the proper quantity of air adjusted to suit it by means of the regulator *c*.

Arrangement for Boiling and Evaporation.—Fig. 3 represents this gas furnace arranged for boiling and evaporation. *a*, is the gas-burner, Fig. 1; *b*, an iron stool with three legs; *c*, a furnace body, or iron jacket, lined with plumbago or fire-clay. Fig. 4 shows the jacket and lining in section, and marks the position of the fire-box, *d*, of the gas-burner. This furnace is 14 inches high, and 9 inches in diameter. The three brackets fixed on the upper part of the jacket serve to support the vessel that contains the liquid that is to be boiled or evaporated. A porcelain basin of 16 or 18 inches in diameter can be thus supported. It is important to allow between the jacket *c* and the evaporating basin plenty of space for the escape of the heated air, which ascends from the interior of the furnace. When the evaporating basin is of small diameter, it may be supported on iron triangles, placed in the furnace *c*. Fig. 4 shows that, around the vertical tube of the gas-burner, *a*, there is in the bottom of the furnace, *c*, a circular opening, which is of 2 inches diameter, and through which air passes freely, partly to feed the flame and partly to be heated by the flame, and be directed upwards in a continuous current upon the lower surface of the basin that is to be heated. The flame within the furnace burns steadily. No side currents of air agitate it. No part of it touches, or must be permitted to touch, the basin, which should receive its heat solely from the mass of ascending hot air. The gas-burner thus arranged, and supplied by a gas-pipe of $\frac{1}{4}$ inch bore, burns about 33 cubic feet of gas in an hour, and the flame which it produces, acting upon water contained in an open porcelain evaporating basin, will heat from 60° to 212° F.,—

Fig. 3.

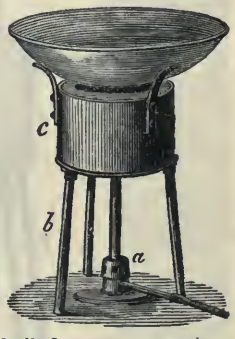


Fig. 4.

1 quart in 5 minutes
1 gallon in 15 „
2 gallons in 30 „

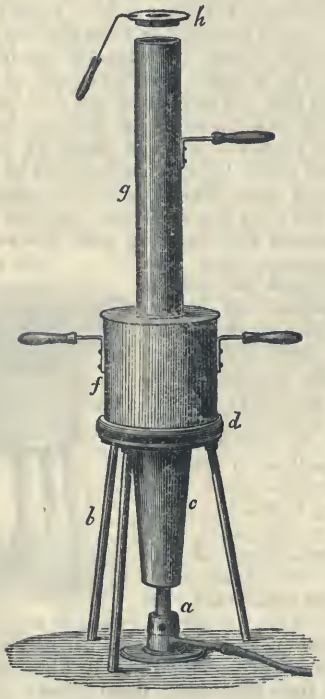
and when the water boils it is driven off in steam at the rate of more than a gallon of water per hour. The method is consequently applicable to distillation on a small scale, and to numerous operations in pharmacy.

[1] See Chemical News, vol. i. p. 27, and vol. iii. p. 333.

[2] Fig. 2 represents a small variety of this gas-burner, in which the head is not removable, but the efflux of the mixed gases is regulated by a sliding valve, which is represented by *b*.

Arrangement for Heating to Redness a Large Fire-clay Crucible.—When a large crucible is to be heated to redness—as, for example, when oxide of copper is to be dried for use in an organic analysis,—the gas-burner is to be used without the fire-box *d*, Fig. 1, and is to be arranged with the furnace fittings that are represented in perspective by Fig. 5, and in section by

Fig. 5.



the lower part of Fig. 8, *a*, *b*, *c*, *d*. Letter *a* represents the gas-burner, Fig. 1; *b* is a tall iron stool; *c*, a chimney which collects atmospheric air to feed the flame, and leads it up close to the vertical tube *b*, by which contrivance the air is warmed and the tube cooled; *d* is a furnace-sole or plate of fire-clay; *f* is a reverberatory dome, the interior of which is best shown in the section, Fig. 6; *e* is a cast-iron ring or trivet, represented more clearly in Fig. 7; *g* is an iron chimney,

Fig. 6.

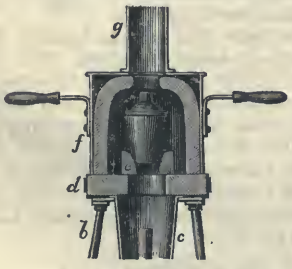


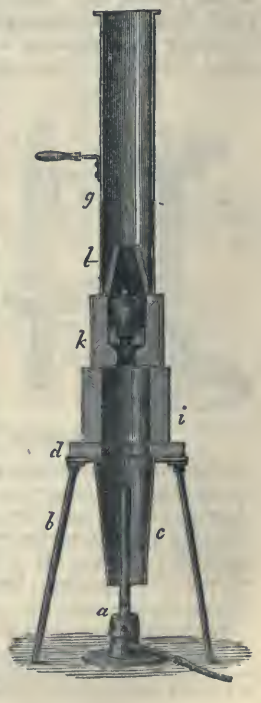
Fig. 7.

24 inches long, and 3½ inches wide; and *h*, a damper, to lessen the draught when small crucibles are to be heated. The height of this apparatus, from *a* to the top of *f*, is 24 inches; and the external diameter of the dome *f* is about 8 inches. The crucible, which may be from 4¼ to 4¾ inches in height, is placed on the iron ring *e*, and that on the clay sole *d*, and it is then covered by the dome *f*. The gas should be lighted after the crucible is placed in its position, and before the dome is put on. The dome and chimney are then to be added, and the operation allowed to proceed. With a crucible of the above size, the damper *h* is not required; but it must be used when the crucible is under 4 inches in height, otherwise the draught occasioned by extra space within the dome causes the flame to blow down. The damper must be put on the chimney before the chimney is put on the dome. The iron ring, Fig. 7, or *e*, Fig. 6, suits crucibles of different sizes, according to the side of it which is turned uppermost.

The Figures show that a crucible mounted in this furnace can lose very little heat by radiation or conduction, and hence it is that a small gas flame produces a powerful effect. In half-an-hour a 4¾-inch clay crucible, filled and covered, can be heated to full redness. The progress of the ignition can be easily examined by lifting up the chimney *g* and the dome *f* by their respective wooden handles. But the action of the furnace can also be judged of by a peculiar roaring noise which it produces. If the gas and air are mixed in due proportions, the roar is regular and continuous. If there is too much gas, the roar is lessened. If too much air, the roar is increased, but is rendered irregular and intermittent. The greater the noise, the greater the heat in the furnace, but when the roar becomes spasmodic, the flame is on the point of blowing down. To prevent that occurrence, the proportion of air must be lessened or that of gas increased.

Arrangement for Heating Platinum Crucibles, as in the Fusion of Silicates with Anhydrous Carbonate of Soda.—The following arrangement is convenient when small crucibles are to be strongly heated:—Anhydrous carbonate of soda in quantities exceeding 1000 grains can be thus readily fused, and small quantities of sterling silver can be melted in a clay crucible. It is also available for ignitions or fusions in small porcelain crucibles. Fig. 8 represents the arrangement of apparatus as seen in section. *a* is the gas-burner; *b*, the stool; *c*, the air-chimney; and *d*, the furnace sole, as already explained. *i* is a cylinder of fire-clay, 5 inches high, and 4 inches diameter; *k* is a plumbago or fire-clay furnace, in which is placed a small cast-iron ring, similar in form to that represented by Fig. 7, and on this ring the platinum crucible is adjusted; *l* is a fire-clay or plumbago reverberatory dome; and *g* is the chimney that forms part of the furnace represented by Fig. 5. The crucible being adjusted, the gas lighted, and the dome and chimney put on, the lapse of 12 or 15 minutes, according to the

Fig. 8.



quality and pressure of the gas, suffices for the fusion of 1000 grains of carbonate of soda in a platinum crucible.[3]

It will be noticed in Fig. 8 that the crucible is placed very high above the orifice of the tube *a*, at which the gas is inflamed. The distance is, in fact, about 10 inches, the point of maximum heat in the flame being at nearly that distance from the burner, more or less according to the pressure and the quality of the gas. The gas which rises from the burner *a*, though mixed with as much air as it will bear without becoming explosive when lighted, does not contain sufficient oxygen to burn all the carbon present in it. The flame produced is, consequently, quite superficial. The gaseous mixture only burns on the surface where it is in contact with fresh atmospheric air, and it requires time to take up the requisite amount of oxygen. The draught produced by the joint action of the two chimneys *c* and *g* carries the flame rapidly to a great height before the point of complete combustion is attained.

When the highest degree of heat is not required, the reverberatory dome *l* may be omitted. It must also be dispensed with when the crucible that is to be heated is of comparatively large size, because it is then liable to lower the temperature of the furnace by impeding the draught.

The effects that have been ascribed to the various arrangements of this gas-furnace can be produced with gas supplied by a pipe of a ¼-inch bore, and at a moderate pressure, giving from 30 to 40 cubic feet per hour.

The principles of heating by gas, which have led to the construction of this furnace, may be summed up as follows:—When a crucible or other solid body is to be heated, it is to be wrapped in a single flame at the point of maximum heat, and loss of heat by radiation and conduction is to be prevented by the interposition of non-conducting materials (plumbago or fire-clay); and when liquids are to be boiled or evaporated, particularly when they are contained in vessels of glass or porcelain, the flame is to be broken up into numerous horizontal jets, and these are to be made to supply a large and regular current of highly-heated air, by which alone, and not by the direct application of the flame, the vessel that contains the liquid is to be heated. In both cases provision must be made to secure a sufficient draught of air through the furnace, because every cubic foot of gas requires for combustion 10 or 12 feet of cubic air, and the gases which have done their duty must be rapidly carried away from the focus of heat. If the steam, the carbonic acid gas, and the free nitrogen, which constitute the used up gases, are not promptly expelled, fresh gaseous mixture, in the act of producing additional heat by combustion, cannot get near the object that is to be heated, and the heat so produced out of place is wasted.

[3] If this quantity of fused carbonate of soda is permitted to cool and consolidate in a platinum crucible, the salt is liable to expand and burst the crucible.

Casella's New Mercurial Minimum Thermometer.

A GOOD minimum thermometer has long been a desideratum to the scientific meteorologist. Hitherto, alcohol has been employed, but the constant sources of error arising from the use of this fluid, owing to its sluggishness, unequal expansion, and tendency to distil over into the upper part of the tube, rendered it very desirable to employ the same fluid—mercury—for registering extreme cold that is always used for estimating heat. Several contrivances have already been suggested for effecting this object. Cumbrous arrangements of tubes were devised by men of science, which were most skilfully made by Mr. Casella, and still the difficulty remained almost as great as ever, until the construction of such an instrument was pronounced by one of the first authorities in England to be a physical impossibility.

The idea at length occurred to Mr. L. M. Casella that by a judicious adaptation of the parts of the instrument, so that the two forces, adhesion and gravitation, should be opposed to each other, the object so much desired might be attained; and, after many fruitless efforts, the application of this theory was crowned with success, and the result is embodied in the beautiful instrument now before u .

The peculiarity consists in the attractive or adhesive influence obtained by the junction of the small chamber (*a*, *b*), with the adjoining bent tube or chamber (*d*), as shown in the enlarged view (Fig. 1), the action of which is as follows:—On the instrument being set for observation, in a horizontal position, with the back plate (*e*) suspended on a nail, and the lower part supported on a hook (*f*); the bulb end may be raised or lowered, until the bent part (*d*) is full of mercury and the chamber (*a*, *b*) is quite empty; at this point the mercury in the bore of the tube indicates the exact temperature of the air at the time. On an increase of temperature the resistance of capillarity in the bore renders it easier for the mercury to expand into the small chamber (*a*, *b*) than along the narrow bore of the tube (*c*); whilst a return of cold will, for the same reason, cause its recession from this chamber only, until it reaches the flattened surface (*b*), to which the mercury adheres, as to a fixed point; when any further diminution of heat withdraws the mercury down the bore to whatever degree the cold may attain, where it remains until further withdrawn by increased cold, or till reset for future observation.

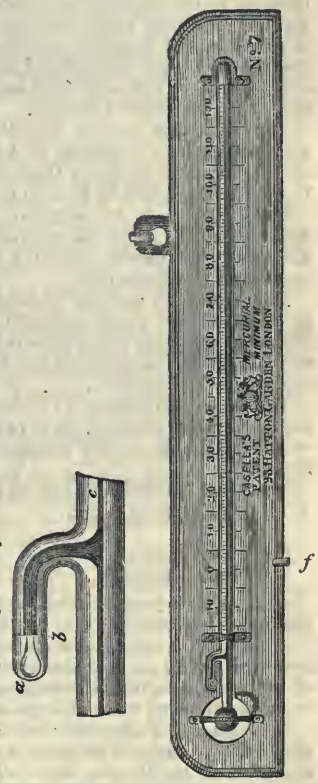


Fig. 1. Fig. 2.

By this means, cold may be registered to any fraction of a degree observable on the most delicate standard, and no vicissitudes of climate or transit can in any way disarrange the instrument.

Solder for Brass Instruments.—An alloy of 78·26 parts of brass, 17·41 of zinc, and 4·33 of silver, with the addition of a little chloride of potassium to the borax, is recommended by Mr. Appelbaum, as the best solder for brass tubes which have to undergo much hammering or drawing after joining.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 15, 1861.

Dr. J. P. Joule, President, in the Chair.

Mr. John Whalley was elected an ordinary member.

A Paper was read by G. V. Vernon, Esq., F.R.A.S., M.B.M.S., "*On the Irregular Barometric Oscillations at Geneva and on the Great St. Bernard, and their relations to the Mean Temperature and the Fall of Rain.*"

The object of this Paper was to deduce the effects produced upon the irregular oscillations of the barometer by considerable difference of elevation. The station at Geneva is the observatory under Professor Plantamour, and is 1335 feet above the sea. The station on the St. Bernard is the Hospice, and the observations made there are also under the direction of Professor Plantamour; its height is 8173 feet above the sea, and, consequently 6838 feet above the Geneva station.

The maximum amount of oscillation occurs at Geneva in January, and the minimum in August. The maximum at the St. Bernard occurs in December, and there appears to be two minima, one in June and the other in August.

Upon the whole, the amount of oscillation appears to diminish as the mean temperature increases, the minimum amount of oscillation occurring somewhat later than the maximum temperature.

The maximum number of oscillations occurs at Geneva in August; and there appear to be two minima, one in February and another in November. At the St. Bernard the maximum number occurs in August, and a single minimum in November.

The mean daily amount for the year at Geneva is 0·1069 inches; annual amount, 39·0719 inches: at the St. Bernard —daily amount, 0.0865 inches; annual amount, 31·5941 inches.

The total annual number of oscillations is, at Geneva, 171·3; St. Bernard, 157·2.

	Geneva.	St. Bernard.
Six winter months	84·4	76·2
Six summer months	86·9	81·0

1848 was the year of maximum oscillation, and 1857 of minimum oscillation.

A number of oscillations above the average at Geneva is accompanied by a less amount of oscillation than a number of oscillations below the average. At the St. Bernard the exact converse of this holds good.

In January, February, and December, a temperature above the average, at Geneva, is accompanied by a greater amount of oscillation than when the temperature is below the average. During the remaining months of the year the converse of this exists. For the year, a temperature below the average is accompanied by a larger amount of oscillation at Geneva than when the temperature is below the average.

At the St. Bernard, a temperature above the average, in the months of August and September, gives a larger amount of oscillation than a temperature below the average; during the other months of the year the converse of this holds good. For the year, a temperature below the average gives the largest amount of oscillation, as at Geneva.

A number of oscillations in excess of the average at Geneva, in the months of January, March, June, July, August, and November, is accompanied by a larger amount of oscillation than when the number is below the average; during the rest of the year the converse holds good. For the entire year, an increased number of oscillations is accompanied by an increased amount of oscillation.

At the St. Bernard, a number of oscillations above the average, in the months of January, February, March, April, May, August, September, and November, is accompanied by a larger amount of oscillation than when the number of oscillations is below the average. In the remaining months of the year the converse of the above holds good. The mean of the year gives the same results as Geneva.

A rain fall above the average, at Geneva, is accompanied by a larger amount of oscillation, in every month of the year, than when the rain fall is below the average.

At the St. Bernard, a rain fall above the average, in the months of February, March, May, July, August, November, and December, is accompanied by a larger amount of oscillation than a rain fall below the average; during the remainder of the year the converse of this exists.

On the mean of the year, a rain fall above the average is accompanied by a less amount of oscillation than a rain fall below the average. This result is curious, being the direct converse of what was obtained for Geneva.

The conclusions which may be drawn from this investigation are the following. As we ascend in the atmosphere, the amplitude of the irregular diurnal oscillations of the barometer dimishes, more especially in the winter months; the summer months having an amount of oscillation not differing much from that of less elevated stations in nearly the same geographical position.

Excessive rain fall at stations of moderate elevation appears to be accompanied by a larger amount of oscillation than when the rain fall is below the average. At more elevated stations it appears as if this law was reversed, and, if found to be so, will be a very important fact.

Temperature below the average for the season greatly increases the amount of oscillation.

NOTICES OF BOOKS.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

FIFTH NOTICE.

Under another head may be classed those processes in which hydrofluoric and hydrofluosilicic acids are employed alone or in combination with certain mineral bases. The suggestion of Professor Field and Dr. Bernays is founded on the employment, firstly, of hydrofluosilicic acid alone for the purpose of ensuring a thorough penetration of the stone, which, in the case of dolomite, is said to amount in depth to about an inch of stone penetrated in the course of half-an hour. In the treatment of moderately compact descriptions of calcareous building-stone the hydrofluosilicic acid is applied as before, but subsequently washed over with a dilute solution of ammonia for the purpose of depositing gelatinous silica in the pores of the stone, and at the same time inducing the formation of a difficultly soluble compound, the fluoride of calcium. In the course of manufacturing the acid on any considerable scale, large quantities of flocculent silica are obtained as a secondary product, which it is proposed to economise by dissolving in potash, and using such solution in combination with the ingredients previously enumerated.

According to the degree of concentration of the acid employed, so will the effervescence, due to its action on the earthy carbonates of the stone, be more or less appreciable. Dr. Bernays prefers to use a very weak acid for the first application, and in that case the evolution of carbonic acid gas is scarcely perceptible, and cannot be supposed to present a barrier to the free absorption of the chemical agents into the substance of the block. The efficacy of the process does not appear to depend upon the production of a hard, superficial coating, but rather to encrust all the exposed faces, and to some extent even below the surface of the stone with a durable protective layer, composed of

silica and fluoride of calcium in intimate union. It is asserted that the nature of these materials particularly qualifies them for resisting the action of those atmospheric influences to which dolomite seems especially sensitive. In the experiments of Dr. Bernays and Professor Field, blocks of Caen stone are described as having been taken to represent the material operated upon; but, strange to say, they make no mention of the modifications which would be introduced into the chemical reactions by the presence of the large proportion of carbonate of magnesia in dolomite—that kind of building-stone for which this special plan of treatment has been particularly devised.

In some respects similar to the foregoing is the process suggested by the Editor of this Journal. This refers to the employment of a preparation obtained by acting upon clay, kaolin, or Fuller's earth (silicate of alumina), with hydrofluoric acid. The chemical decomposition called into play when these ingredients are brought together is very complex, but we have ascertained that silico-fluoride of aluminium is formed as the chief product. The acid properties, although partly neutralised, are still capable of giving rise to an effervescence by contact with chalk; and to avoid too copious an evolution of carbonic acid from the limestone, dolomite, or other building material submitted to its action, it would in some cases be deemed advisable previously to correct any excessive degree of acidity by the cautious addition of an earthy base. A single wash merely of this solution is recommended to be applied direct to the surface of the stone. The principle upon which the employment of this compound is based cannot be fully explained while chemists are still in doubt respecting the complex changes brought about by the mutual reaction between fluorine and silicium compounds with lime, magnesia, and alumina as bases. The products are, however, distinguished in all cases by their insolubility, and it is proposed to take advantage of the precipitation of such substances in the pores of stone as a means of protecting the exposed surfaces from the destructive influences of the surrounding atmosphere. According to one view, the result of employing a wash of the silico-fluoride of aluminium upon a calcareous stone will be the formation of silicate of alumina and fluoride of calcium; or otherwise if account be taken of the tendency of fluoride of aluminium to form double compounds by union with other fluorides, a kind of kryolite, in which sodium is replaced by calcium, may possibly be produced. Which ever view regarding the chemical constitution of the product be correct, it is our aim to produce through the agency of the substances described an insoluble mineral coating calculated to afford a considerable amount of protection to the surface of the stone.

A third process of the fluorine class is the subject of a provisional patent granted to Messrs. Jesse Rust and Company, who have, through the principal member of their firm and Mr. John Mossop, submitted to the Decay of Stone Committee the full particulars relating to their invention. This consists in the employment of two washes, the first an aqueous solution of caustic baryta, and the second hydrofluosilicic acid, by which double treatment the comparatively insoluble silico-fluoride of barium is formed by precipitation in the pores of the stone; or, according to a second opinion suggested by Mr. Rust, "the fluo-silicic acid combines with the baryta, forming fluoride of barium, which is insoluble in the acid itself, and the silica is set free. This being likewise insoluble, assists in closing the stone and in rendering it impervious to water." With regard to the preparation of the materials required in the process, a statement is made substantially to the following effect:—For the more economical manufacture of concentrated hydrofluosilicic acid, Mr. Rust departs from the usual system of decomposing gaseous fluoride of silicium by water. From silicate of soda he precipitates, by the addition of an acid, "free silica in the form of a pulp." By now passing hydrofluoric acid gas through this product it is gradually dissolved, and the process is terminated when all is again taken into solution, which is much more readily accomplished than when sand is employed as the source of silica. "With regard to caustic baryta, I am making large quantities. We are glass-makers, and I take a glass pot, broken, that will not serve for glass again, clean it out thoroughly, and put in common native carbonate of baryta. I then expose it in this glass pot to the fire for various periods, say for two or three days, and it comes out perfectly caustic. Of that a great quantity is dissolved in hot water, and in operating upon the stone I use the solution hot, because a larger quantity of baryta is thereby held in solution."

Limestones coated according to the mode of treatment just now described, are said to be altogether protected from the action of weak acid; it is not stated which acid was used in the experiments, and there may be a considerable difference between sulphuric and muriatic acids in this respect; but it appears that whilst one portion of a stone which had been only partially treated was wasted away, the other (coated) portion well resisted the corrosive action. There is one circumstance which we cannot refrain from noticing in connection with the evidence offered by Mr. Rust. Whilst fully admitting the injurious effects likely to arise from the introduction of common salt into the pores of the stone, there is every probability that the method indicated for the preparation of the hydrofluosilicic acid would lead to its contamination by this or another equally injurious soda salt. The "silica pulp" would require very protracted washing to remove all the chloride of sodium adhering to it from its mode of formation, it would, in fact, be found difficult to separate the whole of the salt without sacrificing a considerable proportion of the soluble silica. All the salt left in the silica must reappear in the hydrofluosilicic acid, and consequently be eventually transferred to the block of stone.

The process of treatment suggested by Mr. Spiller, forms an isolated example of the application of phosphoric acid for the purpose of arresting decay in stone. According to this proposition, it is recommended to employ a solution of superphosphate of lime, which, applied as a single wash, has a very considerable power in hardening the exterior surfaces of all building stones that contain carbonate of lime as their principal constituent. With the object of effecting a more thorough penetration of the stone, it is in some cases considered advantageous to employ first a moderately dilute solution of the superphosphate, and to follow up this treatment with a second wash of the same, applied this time in a more concentrated form. A slight effervescence is apparent as the result of the chemical action of the superphosphate upon the carbonate of lime in the stone, and the change in the mineral constitution by which this is accompanied consists in the gradual transformation of a soluble acid phosphate into two equivalents of neutral phosphate of lime, which from their slow production and sparing solubility are separated in a crystalline condition, and go far towards filling up the smaller interstices of the stone. The porosity of a small block is shown by this means to have been diminished by about one-half; the piece of stone which originally absorbed eight per cent. of water, was after treatment capable of taking up only four and a-half per cent. From comparative experiments upon Bath and Portland stones, and upon common chalk, the increased degree of hardness becomes very apparent; the last showed this effect in the most conspicuous manner, it being found impossible to scratch with the finger-nail a surface of chalk hardened in the manner described. The action of the several corrosive agents which the treated stone is liable to encounter in the atmosphere, has not yet been fully ascertained; but so far as laboratory experiments indicate, there is every promise that a considerable amount of protection will be afforded by the coating of phosphate of lime.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2370. Charles Stevens, Charing Cross, London, "Improvements in the manufacture of steel, and in the hardening of metals."—A communication from Joseph Théophile Luce Rousselot, Paris.

2386. George Davies, Serle Street, Lincoln's Inn, London, "Improvements in the process of preserving provisions, and in the apparatus employed therein."—A communication from Alexander Lecomte, Montmartre, Paris.—Petitions recorded September 24, 1861.

2396. Thomas Richardson, Newcastle-upon-Tyne, "Improvements in the manufacture of muriate of iron for the purification of coal gas."

2410. Victor Sosthene Lete, Paris, "Improvements in aërated or sparkling white wines."

3412. William Clark, Chancery Lane, London, "Improvements in the manufacture of peat."—A communication from Auguste Marcelin Manrique Comte de Lara et du Ren, Boulevart St. Martin, Paris.—Petitions recorded September 26, 1861.

2440. Frederick Walton and Richard Beard, jun., British Grove Works, Chiswick, Middlesex, "Improvements in the manufacture of varnishes applicable to the waterproofing and coating of fabrics and other uses."—Petitions recorded September 30, 1861.

2456. William Maltby, De Crespigny Park, Camberwell, Surrey, "Improvements in the manufacture of starch and starch gum."

Notices to Proceed.

1382. William Albert Shepard, Pall Mall, London, "Improvements in obtaining products from coal, and in apparatus employed therein."—Petitions recorded June 1, 1861.

1392. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "An improved combination of metals for the production of a white alloy resisting the action of vegetable acids."—A communication from Benoni Ferdinand Trabuc, Nîmes, Gard, France.

1396. Henry Herbert Hazard, Nelson Terrace, City Road, London, "Improvements in cartridges."

1397. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in the manufacture of gas, and in the apparatus connected therewith."—A communication from Messrs. Schaeffer and Walcker, Berlin, Prussia.

1406. Heinrich Gottlieb Bernhard Roeber, Silvertown, Essex, "Improvements in the manufacture of insulators for telegraph wires, and in materials and machinery for coating telegraph wires."

1473. Andrew Brown, Waterloo Road, Liverpool, "Improvements in obtaining fresh water at sea by means of distilling apparatus combined with the cooking stoves, or otherwise."

1512. Robert Jobson, Dudley, and Cromwell Fleetwood Varley, Fortess Terrace, Kentish Town, London, "Improvements in posts or supports for telegraph wires."—Petitions recorded June 12, 1861.

1548. Thomas Routledge, Eynsham Mills, near Oxford, "Improvements in the manufacture of paper."

1616. Richard Howson, Middlesbro'-on-Tees, Yorkshire, "Improvements in barometers."—Petitions recorded June 24, 1861.

1640. John Cowan, Barnes, Surrey, "Improvements in apparatus for reburning animal charcoal."—Petitions recorded June 26, 1861.

1722. William Pask, Lydney, Gloucestershire, "Procuring a colouring matter from the refuse of ironstone called colour spert."—Petition recorded July 6, 1861.

2395. Alfred Vincent Newton, Chancery Lane, London, "Improvements in the construction of and mode of working telegraphic apparatus."—A communication from Giovanni Caselli, Florence, Italy."—Petitions recorded September 25, 1861.

CORRESPONDENCE.

On the Estimation of Nitrogen in Manures and Other Substances.

To the Editor of the Chemical News.

Sir,—In the Chemical News of October 12 are published some remarks by M. Carey Lea on my process for the estimation of nitrogen or ammonia by means of chloride of zinc.

I regret that such a task falls to my lot as that of pointing out the errors of an eminent scientific man; but, in order to vindicate myself, it seems necessary that I should do so. The process upon which he has so freely given his opinion has evidently never been tried by him, his opposition being altogether upon theoretical grounds, and by his non-practical conclusions has undoubtedly done me an injustice. He remarks, "The proposal of a new mode of analysis such as that of Mr. Walker is a new proof how much it is to be regretted that any chemist should offer a new mode of analysis without having first controlled it by the analysis of one or more specimens of substance of known composition."

I perfectly agree with him that it would be matter for regret that any chemist should propose a new mode of analysis without having done all, and even more than he suggests.

The very fact of its having been practised by me for two years before being published, is surely proof enough that ample time had elapsed to give opportunity of testing its accuracy; as, during that time, upwards of one hundred estimations were made. It did not occur to me at the time to give along with the process the comparative results, as I considered that anyone trying it would test its accuracy for himself; but, in order to satisfy the gentleman who writes against the process that he has no foundation for accusing me of such inconsistency as recommending a process as accurate without first having satisfied myself that it was so, I give a few results, copied from my analysis-book.

I have taken the results obtained by the platina process as the standard of comparison :—

			By Zinc process.	By Platina process.
No. 1	Superphosphate of Lime.	Ammonia per cent.	0·54	0·64
,, 2	,,	,,	0·66	0·78
,, 3	,,	,,	0·28	0·33
,, 4	,,	,,	0·21	0·27
,, 5	Dissolved Bones.	,,	2·12	2·00
,, 6	Manure.	,,	3·33	3·15
,, 7	,,	,,	1·33	1·20
,, 8	,,	,,	3·68	3·42
,, 9	,,	,,	4·63	4·62
,, 10	Hoof and Horn Cuttings.	,,	14·85	14·58

Five of these analyses by the platina process (Nos. 2, 3, 4, 5, and 9), and two by the zinc process (Nos. 5, and 9) were done by other chemists.

Analytical chemists, who know the difficulty of obtaining exactly similar results, even by the same process, will agree with me that those before us show a very trifling discrepancy, and surely justify me in saying, that I was sufficiently guarded in my statements, when recommending the process, and they likewise show that no dependance whatever can be placed on mere theoretical demonstrations, such as those M. Carey Lea has treated us to; that gentleman most emphatically declares that, "The necessary result must be an under-estimation of the ammonia, leading to errors of such magnitude as would render the process wholly unfit even for the roughest technical analysis."

It is a pity that he should have committed himself in

this way, as I can most emphatically assert that an under-estimation of the ammonia is quite exceptional, and when it does occur is mostly with substances very poor in ammonia, and even then of comparatively trifling amount: the tendency of the process is rather to slightly over-estimate it, taking as the standard of comparison the results obtained by the platina process.

Following up M. Carey Lea's process of reasoning, he takes a neutral solution of chloride of zinc, adds one drop of ammonia which occasions a precipitate, then adds, I presume, about a thousand drops of solution of chloride of ammonium when the precipitate is re-dissolved. True enough all this occurs; but why add solution of chloride of ammonium? it forms no part of the process recommended by me. This experiment appears to be the sum total of evidence against the process and should only pass for what it is worth. It comes to this: To what extent is oxide of zinc soluble in chloride of ammonium? I would have liked very much had M. Carey Lea informed us. His remarks made me curious on this point especially as the practical results do not at all agree with his theory, and I have consequently made some experiments with the view of answering the question. I took three equal quantities (Nos. 1, 2, and 3) of a solution of chloride of zinc specific gravity 1·012 and to each added equal quantities of solution of pure caustic ammonia. From No. 1 I collected the precipitate, washed, dried, ignited, and weighed. I found the weight to be 6·15 grains. From No. 2 I collected the precipitate and washed thoroughly. I then made a hole in the filter and washed the precipitate into an empty test glass, then added a solution of chloride of ammonium of known strength agitating the mixture well upon each addition until only a slight trace of the precipitate remained undissolved. By this method I ascertained that it required 450 grains of chloride of ammonium to dissolve 6·15 grains of oxide of zinc. To No. 3 I added solution of chloride of ammonium of the same strength as that added to No. 2, and found that it required 560 grains to dissolve 6·15 grains of oxide of zinc.

The solution of chloride of ammonium contained 100 grains per alkalimeter, and had a sp. gr. of 1·03. From these results may be deduced what influence the presence of chloride of ammonium will have in the analytical process, and as the oxide appears to be less soluble in a mixture of chloride of zinc and chloride of ammonium than in chloride of ammonium alone, it is but fair to test it by that standard.

The average amount of ammonia contained in manures is about 3 per cent., and 30 grains are generally taken for an analysis; this will produce a precipitate of oxide of zinc weighing 2·14 grains, and chloride of ammonium in solution weighing 2·82 grains, which will dissolve 0·03 of a grain of oxide of zinc equal to 0·04 per cent. of ammonia.

This trifling discrepancy surely cannot be enough to stigmatize the process as "grossly inaccurate," as often far greater differences are observable when two analyses of the same substance are made by the platina process, which as far as I can learn, is generally considered to be very accurate although tedious.

I have only, in conclusion, to reiterate my former statement made nearly twelve months ago, with this difference, that I have practised the process for nearly three years instead of two, and as it gives accurate results, I can with confidence recommend it.—I am, &c.

James Walker.

Crawford Street Chemical Works, Glasgow.

Estimation of Alcohol in Wine.

To the Editor of the Chemical News.

Sir,—In your last Number Mr. Horsley gives a method of determining the alcoholic contents of wines, which, from the absence of any acknowledgment, I infer he wishes to pass off as his own. It should be known, then, that this method is to be found at page 157 of the translation of Mulder's "Chemistry of Wine," by Dr. Bence Jones. It was given, you may remember, at page 36, vol. 1 of the Chemical News, and excited some discussion at the time.

I am, &c. Suum Cuique.

P.S.—The special application is, of course, Mr. Horsley's.

October 24.

Quality of Water at Leeds.

To the Editor of the Chemical News.

Sir,—I have been given to understand that some of the waters supplied to Leeds or its vicinity, and used for dyeing and other similar purposes, are so impregnated with iron as to be very objectionable. Could you or some of your readers inform me what are the sources of the Leeds water supplies, which of them furnish water containing iron, what analyses have been made of the latter, and what are the means used (if any) to get rid of the impurity in question?—I am, &c. J. B. M.

MISCELLANEOUS.

Chemical Society.—The first meeting of the season of this Society will take place on Thursday next, November 7, at Burlington House. Chair to be taken at 8 p.m.

Nitrates in Well-water.—In reference to Dr. Haines' paper on "Nitrates," the following analysis of a well-water at Tewkesbury, analysed by Herapath, has been forwarded to us:—

Chloride of calcium . . .	37·02
Nitrate of lime . . .	45·06
,, potash . . .	42·09
Sulphate of soda and magnesia .	86·97
Chloride of sodium . . .	21·76
Carbonate of lime and magnesia	73·30
Sulphate of lime . . .	40·09
	346·29

Photo-Electric Apparatus.—A Trappist named Delalot-Sevin, of the Abbaye de la Grâce-Dieu, has invented a new pile, much stronger, and at the same time much cheaper, than the pile of Bunsen. By means of his photo-electric apparatus he produces an electric light as cheap as gas, and with his thermo-electric pile he supplies caloric on economic terms hitherto unknown. Several of these apparatus have been constructed, and one is at full work in the Abbaye of La Grâce-Dieu. Manufactories for the public are shortly to be established in Paris and at Lyons. The apparatus for producing gas will not be given to the public until after the Exhibition at London next year, but that for heating buildings will be made public on the 16th of December next. The inventor has been authorized to make public experiments with his system of lighting on the Place Saint Jacques in Paris, and on the Place Bellecourt at Lyons.

Curious Lunar Phenomenon.—F. M., writing from High Wycombe, on the 17th October to the *Morning Star*, says, "Can I claim a corner for the following account of a remarkable and extraordinary appearance I witnessed on the disc of the moon on the night of the 14th, about nine o'clock, with an achromatic telescope, magnifying power about 170? In examining the cup-like cavities situated near the bright spot Kepler, on the irregular edge of the planet, I observed four smaller spots, in the shape of an irregular square, standing out in bold relief in the dark sky, surrounded by or emitting a beautiful prismatic luminous light, twinkling like the bright star Sirius. Having from time to time observed the moon

pretty nearly in all its phases, I never saw before the cup-like cavities of that orb as I did then, and in that particular spot, sparkling like some variegated coloured gems. At the time I could not account for it. I thought probably my glass deceived me; but recollecting that it was a pure achromatic lens, free from colour, I could not come to any other conclusion than that the spectacle was four active volcanoes in operation. The luminous light I observed was the reflection of external fiery matter pouring down the sides of the central mountains out of the mouth of the volcanoes. I merely state what I saw, and venture my humble opinion, subject to correction, drawing my conclusions. I always supposed the moon devoid of an atmosphere, but if the above, as I assume, were volcanoes, as a matter of course taking that body to be of the same organisation and the same matter as our earth, an atmosphere must be necessary for combustion in that body as well as for the latter. Perhaps, Mr. Editor, some of your numerous readers can explain the phenomena I witnessed."

Discovery of Gold in the Valley of the Saskatchewan.—Mr. A. K. Isbister, author of a paper on the Hudson's Bay Territories, says:—"I have just received a letter from the Red River colony, in the Hudson's Bay territory, announcing the discovery of a valuable gold field by a party of American miners from California, on the north branch of the Saskatchewan. This intelligence I see confirmed in recent papers published at St. Paul's, Minnesota, and it may therefore be relied on as accurate. Two gentlemen from California have recently arrived in that town with a considerable quantity of gold collected by themselves along the upper waters of the Saskatchewan, and they describe the yield and quality of the metal as promising to be quite equal to that of British Columbia, which I need hardly say occupies the opposite flank of the Rocky Mountains, and may therefore reasonably be inferred to be of a similar geological character, while we know that it is watered by streams which have a common origin in the same auriferous range with the northern tributaries of the Saskatchewan."

Action of Poison on Wild Animals.—For the purpose of poisoning them strychnia is used. I have tried aconitine, atropine, and corrosive sublimate without success. The two former may not have been pure enough, though I obtained them from the first chemical works in England and at a very high price. The only poison that I have found strong is strychnia. One or two grains of this are mixed with a little tallow, forming a small ball, and covered with a coating of grease outside to prevent the animal from tasting it. A quantity of pounded dried meat and morsels are strewn about so that the animal after swallowing the poison may be detained a sufficient time for it to operate. The distances which animals go before they die vary greatly; in some instances they fall directly, in others they run several miles with the same dose, and arranged in like manner. This I attribute to several causes; to their fatness, and to the quantity of food in their stomachs, as lean and hungry foxes die much more quickly than others. The medium in which the poison is given also causes a great difference. When put up in fresh meat a very long time elapses before it operates. Wishing to preserve a specimen of the Hare-Indian dog for the Smithsonian Institution, I resolved to kill the animal by poisoning. Two grains of strychnia of the first strength were administered in a piece of fresh meat; at the end of two hours the animal was as well as ever. I then administered one grain more mixed with grease, in two minutes the spasms began, and in five the animal was dead. The first symptoms were a restlessness and contraction of the pupil of the eye, and a flow of saliva from the mouth, violent cramps then ensued, the head shook violently, like a paralytic person, the legs were drawn up, and the spine took a circular shape, a lull of a few seconds then ensued, when after an attack of great violence the animal died. On dissection the blood vessels of the head and neck were found very full of black and clotted blood, such as I have seen in the jugular vein of a person who had died of apoplexy. There was no inflammation of the stomach, and the fatal bait was found in the throat entire. Once seen, the symptoms of poisoning by strychnia are easily recognised, and I would be certain now of passing a correct opinion on a case of the kind. Dogs take a longer time to expire than either wolves or foxes; the latter dying most quickly; in fact according to the ratio of the wild nature of the animal who eats it will be the quickness and violence of its death.—*B. R. Ross, in the "Canadian Naturalist."*

On the Natural Dissemination of Gold.—Mr. Eckfeldt, the principal assayer of the United States Mint at Philadelphia, has lately made several interesting examinations tending to show the very wide distribution of gold. Passing over the evidence respecting its presence in various galenas, in metallic lead, copper, silver, antimony, &c., we recite the following, perhaps the most curious result of all:—Underneath the paved city of Philadelphia there lies a deposit of clay, whose area, by a probable estimate, would measure over three miles square, enabling us to figure out the convenient sum of ten square miles. The average depth is believed to be not less than fifteen feet. The inquiry was started whether gold was diffused in this earthy bed. From a central locality, which might afford a fair assay for the whole, the cellar of the new market house in Market Street, near Eleventh Street, we dug out some of the clay at a depth of fourteen feet, where it could not have been an artificial deposit. The weight of 130 grammes was dried and duly treated, and yielded one-eighth of a milligramme of gold; a very decided quantity on a fine assay balance. It was afterwards ascertained that the clay in its natural moisture loses about fifteen per cent. by drying. So that, as it lies in the ground, the clay contains one part gold in 1,224,000. This experiment was repeated upon clay taken from a brickyard in the suburbs of the city, with nearly the same result. In order to calculate with some accuracy the value of this body of wealth, we cut out blocks of the clay, and found that, on an average, a cubic foot as it lies in the ground, weighs 120 pounds, as near as may be; making the specific gravity 1·92. The assay gives seven-tenths of a grain, say three cents' worth of gold to the cubic foot. Assuming the data already given, we get 4,180 millions of cubic feet of clay under our streets and houses, in which securely lies 126 millions of dollars. And if, as is pretty certain, the corporate limits of the city would afford eight times this bulk of clay; we have more gold than has yet been brought, according to the statistics, from California and Australia. It is also apparent that every time a cartload of clay is hauled out of a cellar, enough gold goes with it to pay for the carting. And if the bricks which front our houses could have brought to their surface, in the form of gold leaf, the amount of gold which they contain, we should have the glittering show of two square inches on every brick.

ANSWERS TO CORRESPONDENTS.

Gum Water.—W. C.—The best receipt with which we are acquainted for good gum water which will not crack off nor turn sour is:—Best gum arabic, half pound; loaf sugar, 8 medium sized lumps; creasote, 5 drops; water, to make up the bulk to 20 fluid ounces.

Des Cartes' Principia.—A. K. K.—We have not met with an English translation of this work.

J. Walker.—Received with thanks.

Mr. Bowditch.—The slip is received with thanks. It is very interesting, if true.

E. B.—In our previous Numbers.

Books Received.—Elementary Treatise on Physics, by Professor A. Ganot. Translated and Edited by E. Atkinson, Ph. D., F.C.S. Part I. London: H. Baillière, Regent Street. "The Canadian Naturalist and Geologist" in exchange.

Technologist.—Next week.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Presence of Vanadium in an Aluminous Mineral from the South of France,[1] *by M.* H. SAINTE-CLAIRE DEVILLE.

IN June, 1858, M. Meissonnier, engineer at the mines at Marseilles, sent me some specimens of an iron mineral which was very difficult to treat on account of the infusibility of its slag. This substance, obtained from Baux, near Arles, consisted of small round grains buried in a perfectly crystallised pure limestone.

The analysis which I made of it, after having separated the limestone with weak hydrochloric acid, gave me the following results :—

Alumina	55·4
Oxide of iron, carbonate of lime, and water .	44·6
	100·0

I then recognised it as the mineral to which M. Berthier gave the name of Bauxite. It is a hydrate of alumina which M. Dufrénoy has ranked with gibsite, or rather diaspore. The analysis of M. Berthier, performed on a mineral from Baux, gave him the following figures :—

Alumina	52·0
Oxide of iron	27·6
Water	20·4
Chromium	traces
	100·0

It is very true that fused alkalies become coloured yellow when heated with bauxite, but we shall see a little further on that the colouring matter in this case is vanadium, and not chromium.

From other specimens of this curious substance which M. Le Chatelier found in the Departments of Gard and Var, where it is very common, we found that we had met with the richest mineral of alumina that had yet been discovered. Indeed, some specimens contained as much as from 60 to 65 per cent. of alumina.

The plan which I at first adopted to dissolve this mineral is very simple. It has become, in consequence of the labours which M. Le Chatelier, M. Jacquernart, M. P. Morin, and I have undertaken to extract the alumina and prepare aluminium from it, a complete system of manufacturing industry. I may say that in the factory of Salyndres, where a manufactory of aluminium is now established, this process is daily employed to produce large quantities of aluminate of soda, soluble alumina, and aluminium.

I prepare a concentrated solution (45°) of pure caustic soda, which I introduce into a silver crucible. To this I add a weighed quantity of the aluminous mineral previously freed from chalk by digestion with weak hydrochloric acid in washing, and I slowly evaporate it to the consistency of a thick syrup. It may, however, without inconvenience be evaporated to dryness. This may be useful in a quantitative experiment.

Upon adding water aluminate of water is dissolved, and a silico-aluminate of soda is left with oxide of iron, insoluble in water but soluble in acids. I will examine these two substances successively.

A. Silico-Aluminate of Soda and Oxide of Iron.—When the solid pulverulent matter, insoluble in water, is taken up by nitric acid, it almost entirely disappears, leaving a few grains of considerable hardness.

Corundum.—These grains, which resist the action of acids, dissolve in bisulphate of potash. They consist chiefly of alumina, with traces of iron and titanium. They are corundum.

Silica.—Upon evaporating to dryness the acid liquid and taking up the residue with water containing a little nitric acid, silica is left behind, which may be washed, ignited, and weighed. It soon disappears in weak hydrofluoric acid.

Titanium.—But this silica is not pure, for upon digesting it with sulphuric acid containing 50 per cent. of anhydrous acid, and evaporating until it begins to fume, a soluble substance is extracted from it which is separated by evaporating to dryness and ignition in a platinum crucible. This slightly yellow, flaky substance is then insoluble in the acid. Heated to redness with carbonate of potash, it is transformed into a brilliant saline body, the crystals of which separate from the fused mass at the moment of solidification. On treating the fused mass with water, a titanate of potash is left insoluble in water, but easily dissolved in hydrochloric acid. A portion of this solution treated with a slip of zinc yields a violet blue liquid, in which a dark blue precipitate soon forms, which is gradually whitened by the oxygen in the air. The hydrochloric solution treated by ammonia gives a white precipitate, which, when heated in the reducing flame with a globule of tin, produces a very dark violet blue colour, almost black. It is, therefore, titanic acid.

Soda.—The acid liquid, separated from the silica and titanium, is evaporated to dryness, and heated on a sandbath to about 200°, and then taken up by water, slightly ammoniacal. A nitrate is dissolved out, from which the ammonia is driven off by a gentle heat and the nitric acid by evaporation with excess of hydrochloric acid in a porcelain dish. The solution upon evaporation leaves well-defined cubes of chloride of sodium.

Iron.—The ammoniacal liquid leaves a considerable residue of a strong yellow colour, which dissolves entirely in hydrochloric acid. The iron may be easily separated from it by any well known process.

Alumina.—After the iron, the presence of alumina may be easily shown by methods which need not be detailed here.

Upon making a quantitative analysis by the above

[1] *Annales de Chim. et de Phys.*, lxi, p. 309.

process, and separating the iron and alumina by means of gaseous hydrochloric acid,[2] I found the following results. The mineral was attacked by potash:—

		Oxygen.
Silica	41·9	6
Titanic acid	9·0	
Alumina	25·6	3
Potash	23·5	1
	100·0	

Excess, 1 per cent.

It is seen that this is the proportion of oxygen in Labrador feldspar. Only two or three equivalents of water must be added, which make it a sort of amorphous zeolite. The water is very difficult to estimate, for this body, like zeolite, loses water in a dry atmosphere and absorbs it again in a moist one, so that its normal composition is on this account very difficult to give accurately.

B. **Substances Dissolved in the Soda.**—When bauxite is treated with hot concentrated alkali, and when the insoluble matters which I have just mentioned are separated, the solution contains only alumina, which may be separated from the soda by any well known process.

C. **Aluminate of Soda.**—This solution has a constant composition when prepared with an excess of bauxite; but a definite compound can be obtained with greater certainty by attacking the aluminous mineral in excess with carbonate of soda at a high temperature, as is done every day at Salyndres, and by prolonging the operation until the calcined mixture no longer effervesces with acid. There is thus obtained a neutral solution, taking into consideration the saturating capacity of alumina, and the composition of which is given by the following analysis, which was performed on a specimen obtained with caustic soda and alumina in excess. This solution, treated with hydrochloric acid, evaporated to dryness, gave marine salt, which was weighed, and insoluble alumina, which was ignited and weighed. I found the following proportions of soda and alumina:—

Alumina	53·9	$2\,Al_2O_3$	52·9
Soda	46·1	$3\,NaO$	47·1
	100·0		100·0

which seem to be invariable in all the experiments since made on specimens prepared with carbonate of soda.

However, when the alumina-soda lyes are very concentrated, they deposit a very dense hydrate of alumina, from which the soda cannot be entirely removed by washing. The analysis quoted above was made with a liquid containing about $\frac{1}{6}$th of its weight in alumina, and upon lyes marking 10° on the hydrometer. In all cases the aluminate $2\,Al_2O_3$, $3\,NaO$ appears to be the most stable of all alkaline solutions saturated with alumina. The others may be considered as super-saturated when they deposit spontaneously.

Vanadium.—Some aluminate of soda which I kept for a long time in a well stoppered flask, deposited at the end of some months octohedral crystals of the greatest regularity, which might be taken for alum. These crystals, of which I had only very few, were at first looked upon as an aluminate of soda corresponding to M. Frémy's aluminate of potash, which also crystallises in the regular system, but they lose 48·7 per cent. of their weight by heat. Treated with hydrochloric acid, they disengage chlorine and become of a deep red colour. This characteristic showed me for a certainty the presence of vanadium. Indeed, before the blowpipe they give with phosphorus salt, and in the reducing flame the beautiful green tint of vanadium, becoming yellow in the oxidising flame and orange yellow in the presence of nitre.

Finally, when dissolved in water and treated with sulphide of ammonium, they give the characteristic colour of alkaline sulpho-vanadiates. These crystals, although they show in so marked a manner all the reactions of vanadium, do not really contain much; they are almost entirely composed of tribasic phosphate of soda, corresponding to the salt already known, and which, according to Mr. Graham, contains 56 per cent. of water and three equivalents of soda for one equivalent of ordinary phosphoric acid. According to this hypothesis, which I have not verified exactly, these crystals would be composed of,—

Neutral phosphate of soda	95·4
Neutral vanadiate of soda	4·6
	100·0

The vanadic acid was estimated by dissolving the salt in a little water, placing a piece of sal-ammoniac in the solution, washing the precipitated vanadiate of ammonia with sal-ammoniac dissolved in water, igniting and fusing the vanadic acid before weighing it.

The other elements of the salt were estimated in the following manner:—In the neutral solution from which the vanadiate of ammonia has been separated a little ammoniacal nitrate of magnesia is poured. The precipitate of phosphate of magnesia and ammonia is filtered off at the end of some days, calcined and weighed. The liquid containing the nitrate and chloride of ammonium, with the nitrates of magnesia and soda, is poured into a flask and boiled down with an excess of nitric acid, which burns the ammonia and drives off the chlorine, so that there only remains soda, magnesia, and the excess of nitric acid. The latter is driven off by evaporating to dryness in a platinum dish. Re-dissolve in a small portion of water, and place in the liquid an excess of crystallised oxalic acid. Evaporate again. During this operation the greater part of the nitric acid is driven off by the oxalic acid. Moisten the residue with a concentrated solution of pure tartaric acid, containing only a few centigrammes of acid, dry and calcine, when there is obtained a mixture of magnesia and alkaline carbonates, which are separated by water. The alkalies are estimated in the ordinary manner.

This analysis, performed upon very small quantities of material, and by a method of estimating the phosphoric acid in which I have no great confidence, gave me evidently insufficient results. No simple formula can be deduced from it; it must only be regarded as an approximation. If I can procure a larger quantity of the crystals I will perform the analysis again. These are the results:—

Vanadic acid	4·4
Phosphoric acid	10·4
Soda	32·8
Potash	1·7
Water	48·7
Loss and fluorine?	2·0
	100·0

It may be remarked that, according to the observation, the phosphate of soda, $3NaOPO_5$, containing 56 per cent. of water, and which very probably enters into

[2] *Ann. de Chim. et de Phys.*, third series, vol. xxxviii. p. 21.

the composition of this salt, is insoluble in a concentrated solution of caustic soda; so that all the phosphorus of the aluminous mineral is found in these crystals, of which the quantity is always very small. I had forgotten to say that their production may be hastened by pouring alcohol carefully on to the surface of the aluminate. Care must be taken not to mix the two liquids, as alumina containing soda will then be precipitated, which will interfere with the experiment.

2. Preparation of Vanadium.—The process which I have always adopted to extract vanadium from aluminous minerals consists in treating them with half their weight of concentrated soda lye, to which a little nitrate of soda has been added. After being uniformly mixed, the mass is dried, heated to redness in an earthen crucible, and then extracted with boiling water. The moderately-concentrated solution is then placed in a series of Woolf's bottles, through which a very rapid current of sulphuretted hydrogen is passed. A green coloration is soon developed, whilst the alumina precipitates, and then the liquid becomes of a rose violet, and finally the colour of very deep permanganate of potash. It only assumes this tint after a very prolonged current of sulphuretted hydrogen has been passed through the liquid, the excess of which passing through the first bottles begins to dissolve in the succeeding ones. Then filter and wash the alumina, which is absolutely pure (except perhaps a little phosphoric acid), very dense, and wanting the translucency which is usually possessed by gelatinous alumina as obtained by precipitation with ammonia from an acid liquid. It may be washed with great readiness. The washing water need only be collected so long as they are of a red colour. The sulpho-vanadite of soda has such a considerable tinctorial power that a few centigrammes of vanadium suffice to impart to a litre of water a deep claret colour when in the state of an alkaline sulpho-vanadite.

The red liquid is heated with hydrochloric acid until it is exactly saturated or at most very slightly acid. A brown precipitate mixed with sulphur is thus formed, which is allowed to settle at a gentle heat until the liquid is quite clear and free from sulphuretted hydrogen. The solution is then decanted and the sulphide is collected on a small, thin paper filter, and afterwards burned in an oxidising atmosphere to transform the sulphide of vanadium into fused vanadic acid. The quantity of vanadium which colours these sulphuretted liquids so strongly is really very small; for after the most delicate analyses and the most scrupulous search, I have only been able to find in aluminous minerals the following quantities:—

Mineral from Revest, near Toulon .	0·0009
Mineral from Calabria . . .	0·0006

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, *Member of the Royal Academy of Belgium.*

(*Continued from page* 230.)

Synthesis of Nitrate of Silver.—In order to determine the proportional number of silver with respect to the nitrate of this metal, I have performed the synthesis of the nitrate of silver, as has been already done by MM. Turner, Penny, and Marignac.

I have performed these syntheses in Bohemian glass vessels, and in a platinum retort. For this purpose I have made use of all the arrangements mentioned when describing the synthesis of chloride of silver, to retain during the solution of the metal the nitrate of silver mechanically carried off by the nitrous gas; except, indeed, in one single case, where I effected the solution, the evaporation, and the fusion in a platinum retort, when it was impossible for me to pass the gases through a liquid to deprive them of the mechanically suspended solution of silver. I made use of vessels of different materials in order to examine the action which the fused nitrate had upon the glass.

The silver being dissolved, which requires from twenty-four to forty-eight hours, according to the quantity of metal employed, I incline the globe and adapt the neck to a receiver, and proceed with the complete evaporation of the solution. To effect this, I raise the flask to a temperature approaching, but always below, the boiling point of the contained liquid; this takes from forty-eight to seventy-two hours. When evaporated, I raise the temperature of the nitrate to its fusing point, and keep it there until it is of a constant weight; this sometimes is very tedious. To hasten its drying, and especially to drive away the last traces of nitric acid which the salt retains, I pass into the vessel a current of air which has been first deprived of organic matter by passing through a Bohemian glass tube heated to redness, and containing oxidized copper, and afterwards dried by means of chloride of calcium. I was obliged to pass the current of air over a long column of red-hot oxide of copper before drying it, because I found that the air of my laboratory, or even the external air simply filtered through cotton and then dried, slowly, but continuously reduces nitrate of silver heated to its fusing point, and still more quickly when fused, with elimination of nitric acid.

When the weight of the nitrate of silver was perfectly constant, having made a note of it, I again increased the temperature to fuse the salt, and kept it in a state of fusion in a current of air deprived of organic matter and water, until its weight became absolutely constant. In many experiments I have kept nearly 500 grammes of nitrate in a fused state, from eight in the morning until ten at night, without in the least diminishing its weight.

In spite of the constancy of weight of the fused nitrate, I wished to assure myself that this salt lost nothing when it was fused a second time *in vacuo*. I have thus found that the fused salt does not possess any appreciable tension of vapour, for after having five times exhausted the air, and each time replaced it by pure air, the globe containing 472·416 grammes of nitrate lost nothing in weight.

As the fused nitrate is very slightly hygrometric, a property which the crystallised salt does not appear to possess, I adjusted to the globe during its cooling a tube containing chloride of calcium, or acid pumice-stone, to prevent the access of moisture; besides which, the globe was hermetically closed, except only during the weighing.

Then the cork which closed the neck of the flask, serving at the same time to close the globe, was replaced by another cork, which was slightly grooved, so as to allow the air in the flask to be of the same density as the external air.

The nitrate obtained in every experiment in which I made use of purified air was perfectly colourless in the fused state, and of a pearly white, with a radiating fracture in the solid state; it was always neutral to test paper.

Of the eight syntheses which I give below, four were performed in globes of Bohemian glass, two in retorts of the same glass furnished with a receiver fastened to the

retort, and with a bent tube likewise fastened to the receiver to retain the silver carried off. The last two, VII. and VIII., were executed in platinum.

In No. VII. the solution of the metal was itself effected in a platinum retort. In this experiment I was unable to pass the gases resulting from the solution of the silver in the nitric acid through a liquid to retain the metal carried off. This synthesis, therefore, is necessarily faulty. In the eighth experiment the silver was dissolved in a glass vessel, and the solution with the washing waters of the apparatus were evaporated in the platinum retort. The nitrate was there dried, fused, and kept in fusion for six hours. The two operations performed in platinum have enabled me to appreciate how marked is the action of the air of the laboratory on fused nitrate of silver. I have taken great pains to prevent its decomposition by organic matter.

The identity of the result obtained in Experiment VIII. with the result furnished in Experiments I., II., III., IV., V., and VI., shows that nitrate of silver can be fused in glass without either attacking or decomposing it. Moreover, I have always directly verified at each experiment made in glass, that the weight of the globe was identically the same after as it was before the synthesis: at the most, there might be noticed an increase of weight of three or four milligrammes, due to the silicic acid deposited on the sides and derived from the silicium in the silver.

I have stated above that the nitrate simply dried at its fusing-point, still loses weight when it is actually fused. The average loss is a twelve thousand five hundredth of its weight.

Pure crystallised nitrate of silver, dried for six months under a bell-jar with concentrated sulphuric acid, lost in an experiment tried on a tolerably large scale a four-thousandth part of its weight upon fusion. This salt, which would be considered by all chemists as anhydrous, loses, therefore, three times as much water as the salt obtained by direct synthesis and dried at its fusing-point. It appears to me probable, however, that all the loss experienced by the crystallised salt upon fusion should not be attributed to the disengagement of water; it may be that the air condensed by the small crystalline plates has something to do with it.

Although I think that it is most rational to consider the fused nitrate as a definite compound, I give in the following table the weights of the salt in both cases; besides, whichever hypothesis is taken, the results agree within extraordinarily narrow limits, and present an *ensemble* which does not admit of two interpretations.

Syntheses of Nitrate of Silver.

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the Nitrate of Silver carried off by the gases.	Total weight of the Nitrate of Silver dried at its fusing point. A. In air.	Total weight of the Nitrate of Silver dried at its fusing point. B. Reduced to a vacuum.	Total weight of the Nitrate of Silver kept in fusion until its weight was constant. A. In air.	Total weight of the Nitrate of Silver kept in fusion until its weight was constant. B. Reduced to a vacuum.	Nitrate of Silver produced by 100·000 parts of metal. A. Calculated from the salt dried at its fusing point.	Nitrate of Silver produced by 100·000 parts of metal. B. Calculated from the weight of the salt kept in fusion until its weight was constant.
				First Series.					
				Syntheses made in Bohemian Glass.					
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.		
I.	77·2715	77·2684	·0155	121·5	121·6919	121·6585	121·6749	157·492	157 474
II.	99·9965	99·9925	0·0085	157·4815	157·5025	157·4565	157·4770	157·510	157·481
III.	199·9940	199·9860	0·0860	314·9270	314·9690	314·8910	314·9330	157·485	157·477
IV.	300·0070	299·9960	0·0105	472·3665	472·4303	472·3395	472·4030	157·476	157·471
V.	300·0110	300·0000	0·0130	472·3690	472·4320	472·3480	472·4110	157·478	157·470
VI.	404·9720	404·9970	0·0000	637·6050	637·7550	637·5630	637·7130	157·471	157·463
				Second Series.					
				Syntheses made in Platinum.					
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.		
VII.	200·0080	200·0000	0·0000	314·8880	314·9210	314·8590	314·9010	157·460	157·450
VIII.	200·0080	200·0000	0·0000	314·9460	314·9770	314·9080	314·9380	157·488	157·469
							Mean[1] . . .	157·4857	157·472

Synthesis of Sulphide of Silver.—Up to this time M. Dumas is the only person who has attempted to perform the synthesis of sulphide of silver.

To ascertain the relative proportions of its elements, he has directly sulphurised silver by means of pure silver, which was passed in excess in the state of vapour over the red-hot metal. The mean proportion which he obtained, was one which corroborated Prout's law. In following this method, I made two series of experiments, the first, comprising three syntheses, was effected by leading an excess of pure sulphur, in the state of vapour, over the metal heated to dull redness in a Bohemian glass tube surrounded with magnesia to protect it from the action of the gas flame; in the second experiment I replaced the sulphur by pure and dry sulphuretted hydrogen. In each case I drove out the excess of sulphur by a current of pure dry carbonic acid.

As in a preliminary experiment I ascertained the formation sometimes of traces of sulphurous acid, sometimes of sulphuretted hydrogen, I suspected the presence of oxygen and hydrochloric acid in the carbonic acid which I prepared from hydrochloric acid and marble, passing it first through a hot solution of bicar-

[1] The result of the VII.th synthesis being inexact, for the reason mentioned in the text, I have not taken account of it in calculating the mean.

bonate of soda, and then through chloride of calcium tubes. I therefore took the precaution to pass the carbonic acid before drying it completely,—

1. Through a hot solution of bicarbonate of soda;

2. Over dry bicarbonate of soda, contained in two U-shaped tubes;

3. Through a glass tube, 90 centimètres long, heated to redness throughout, and filled in its first half with copper reduced by hydrogen, and in its second half with a mixture of oxide of copper and of copper reduced by hydrogen.

The apparatus for the disengagement of carbonic acid is terminated by two U-shaped tubes, filled with chloride of calcium, and followed by two others containing pumice stone moistened with sulphuric acid.

The suspected causes of error were found to be real; indeed, although I took the precaution to allow the carbonic acid to disengage for three hours before heating the tube containing copper and oxide of copper, I found unequivocal traces of oxidation of the metal for a length of 5 or 6 centimètres when I heated the tube to dull redness; and, moreover, I found a very appreciable quantity of subchloride of copper formed, an evident proof that the current of gas carried over with it traces of oxygen and hydrochloric acid. As I only made use of a slow current of carbonic acid, I hope that I completely eliminated the above-named causes of error; but if I had to recommence these syntheses I should replace the carbonic acid by nitrogen, which is so easily obtained pure by means of air and red hot hydrogen-reduced copper.

The silver employed in my experiment was rolled between two plates of pure silver. The sulphide of silver produced was beautifully crystallised. To be quite certain of the result, I weighed the sulphide of silver twice: the first time, after having heated it to very dull redness in a current of carbonic acid, and the second time after having heated it in the same current sufficiently high to soften the glass and fuse a portion of the sulphide of silver.

In each case the weight of the sulphide was identically the same, the weighings of the sulphide having been performed in the five experiments three times in air and twice *in vacuo* The results agree so perfectly that it is scarcely possible to imagine a greater precision in experiments. Thus, in spite of the prejudice which I conceived against my first syntheses on account of their disagreeing with those of M. Dumas, I now have not the least doubt of the accuracy of these determinations.

These are the results of the five experiments:—

Syntheses of Sulphide of Silver.

Numerical Order.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Apparent weight of the Sulphide of Silver.	Weight of the Sulphide reduced to a vacuum.	Sulphide of Silver produced from 100·000 part of this metal.
	grammes.	grammes.	grammes.	grammes.	
I.	59·425	59·4225	68·247	68·24823	114·854
II.	104·143	104·139	119·606	119·6078	114·853
III.	191·917	191·9094	220·412	220·4158	114·854
IV.	150·0058	150·000	(2) 172·287	172·2765	114·851
V.	249·061	249·076	(2) 286·078	286·061	114·849
				Mean . . .	114·8522

(2) The weighings of these sulphides have been made *in vacuo*.

(To be continued.)

Notes on Nitrification, by R. Haines, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

As I have already touched upon the question of nitrification, it may not be out of place to indicate the extent to which our knowledge of this process has been advanced by the most recent researches.

Nitric acid, it is well known, exists in the atmosphere, and is brought down with rain as nitrate of ammonia, together with an excess of ammonia in the form of carbonate. From the fact that Cavendish and others obtained nitric acid by passing electric sparks through moist air, the opinion has been hastily adopted, and diffused by means of the ordinary elementary works on Chemistry, that electric discharges in the air are influential, if not principal, causes of the production of this compound.

The exact and elaborate researches of our countrymen, Lawes, Gilbert, and Way, have demonstrated the fallacy of this notion. Large quantities of rain collected in the country during every month of three years, over which the experiments extended, the rain of thunder-storms, the condensed water of fogs and mists, snow and hail, were separately examined by new and refined methods of analysis. The final result may be given in Mr. Way's own words:—

"It appears to me that all we can legitimately prove from these results is, that neither in the case of nitric acid nor ammonia is the quantity present in the air sensibly increased by such influences as electricity, heat, &c.; for, so far as the water of rain is concerned, these compounds of nitrogen are evidently inversely proportionate to the quantity of water falling. In the case of thunder-rain, the fall being slight, we have a large proportion of nitric acid, although, even then, not much greater than is found in the water of fogs and mists when the influence of heat and electricity is not supposed. Where, however, a fair quantity of rain falls, accompanied with thunder, we find only the average proportion of nitric acid."

On the other hand, that nitric acid is produced naturally by the oxidation of ammonia, without the aid of other nitrogenous matter, was proved many years ago by the French Academicians, who, by hanging up a basket of purified chalk, saturated with carbonate of potassa, for a few months, over a vessel containing putrefying bullock's blood, obtained a large quantity of nitrate of potassa.[1] By raising the temperature, this change takes place with increased rapidity. Dumas has shown that by passing moist air mixed with ammonia over chalk moistened with a solution of potassa, at a temperature of 212° F., there is found, in the course of a few days, a considerable quantity of nitrate of potassa.[2] Here, again, chalk appears to be a necessary agent in the transformation; the importance of chalk in both natural and artificial nitre grounds has been already alluded to. M. Boussingault has been engaged in a very extended series of experiments on the proportion of nitrates contained in natural waters of all kinds, from lakes, rivers, springs, and wells, and also in every variety of soil.[3] The results are most interesting, but I cannot do more than glance at the more prominent of them. As to the soils, few were altogether destitute of saltpetre. In the poor soil of dry and exposed forest land, the proportion is at its minimum; in a few such cases no

[1] Knapp's "Chem. Techn.," i. 359.

[2] *Ibid*, p. 358.

[3] *Comptes-Rendus* for January 26, 1857, p. 108. Reprinted in the *Chemist*, N. S. iv., for 1857, p. 497.

nitrates could be detected. In cultivated lands, especially those in which carbonate of lime was naturally contained, or to which it had been artificially added, the nitrates were in very large proportion; in the earth of hot-houses, strongly manured, and kept at a high temperature, it was at its maximum. Argillaceous marl, though uncultivated, always contained much. In the chalk quarries at Meudon, near Paris, the upper strata contained nitrates in considerable quantity; in the lower strata they were altogether absent. With regard to natural waters, their richness in nitrates was found to be intimately connected with the nature of the rock strata through or over which they had passed; in lakes surrounded by primitive (syenitic) rocks the merest traces of nitre were found; in waters flowing from the sandy and quartzose rocks of the Vosges, scarcely stronger traces; but in rivers that rise in or flow over calcareous soils, as the Seine, the proportion was very large, on an average equivalent to 15 parts of nitrate of potassa in a million of water, but varying from 6 to 62 parts in a million. His experiments also confirmed those of other observers as to the vastly-increased quantity of nitrates in the well water of large towns. In the water of a great number of wells in Paris there was never less than the equivalent of 206 parts of nitre in a million (= 1·80 grs. in one imperial pint), rising, in particular cases to so high as 1000, 1500, 2000, and in the highest 2165 in a million, equal to about 18·94 grains in an imperial pint,—nearly approaching the largest quantity found in the wells at Nassik. These estimations were performed by the direct method, or rather by two direct methods, which were always employed comparatively,—namely, the decoloration of indigo, and that of Pelouze, by a proto-salt of iron and permanganate of potassa. (In Mr. Way's experiments, the proportion of nitrates being exceedingly minute, the process was different; the water was evaporated to dryness, the residue re-dissolved, filtered, and re-dried for several times in succession, whereby all the soluble organic matter became insoluble; the pure salts were then heated in a combustion-tube with oxide of copper, and the nitrogen estimated by Dumas's direct method; from this the equivalent quantity of nitrate of potassa was obtained by calculation.) In most of the above cases, the occurrence of nitric acid is explicable, and in all probability, rightly accounted for in the way I have already stated: the ammonia present in the air is brought in contact with oxygen highly condensed, perhaps in a liquid state, in the interstices of porous substances, as chalk, and oxidised to nitric acid and water; thus, $NH_3 + 8O = 3HO + NO_5$,—the excess of ammonia yielding the base, whose affinity for the nitric acid predisposes to the union; the nitrate of ammonia so formed slowly decomposes with the chalk into nitrate of lime and carbonate of ammonia, which latter salt, having a basic reaction, determines, as before, the formation of nitric acid; and so on, *ad infinitum*. Such is the plausible theory of Kuhlmann; and no better can be found.

But this theory leaves unexplained the occurrence of nitric acid in the atmosphere; ammonia there is truly, but neither chalk nor any other porous or gas-condensing material.

The action of electric discharges has been shown to be productive of no appreciable effect whatever. All that appears thus far is, that ammonia must be pre-existent; all nitrogenous compounds (nitric acid included) can, by simple means, be converted into ammonia; therefore, nitrogen must already be in some previous state of combination, otherwise nitric acid will not be naturally formed. It is necessary to say "naturally," because we can form ammonia, and, therefore, nitric acid, from pure nitrogen, by the use of proper materials, aided by a very high temperature, under conditions, that is, which do not occur in nature.

But a very great step in advance has now been made. Nitric acid has been obtained at ordinary temperatures without electricity, by the direct union of nitrogen with oxygen. On November 26, 1855, M. Cloëtz communicated to the Academy of Sciences of Paris a Memoir, containing the results of a series of experiments, of which the following is an abstract:—Atmospheric air, after having been perfectly purified from every trace both of ammoniacal and acid vapours, by passing through tubes containing alkaline carbonates and sulphuric acid, was slowly drawn through a series of flasks containing various substances of an alkaline nature, and more or less porous. The experiment lasted about four months, in the autumn and early in spring, the mean temperature being probably below the average of the year, or 51° F., so that it was little favoured by a high temperature.

The first four flasks contained fragments of recently-calcined brick; in the first, impregnated with solution of pure carbonate of potassa; in the second, with precipitated carbonate of lime; in the third, with precipitated carbonate of magnesia; in the fourth, with both precipitated carbonate of lime and carbonate of potassa. "The next four flasks contained, instead of brick, fragments of pumice, first calcined with sulphuric acid, afterwards washed with distilled water, then again heated to redness without the addition of acid. Each of these flasks contained, like the first four, and in the same order, alkaline or earthy carbonates, alone or mixed."

The ninth flask was filled with broken, porous bones, calcined at a white heat, and impregnated with a solution of pure carbonate of potassa. The tenth flask contained calcareous marl.

After now passing through a column of pumice impregnated with sulphuric acid, in order to remove any ammoniacal vapours which the air might have acquired from the last flask, the current passed successively into four flasks filled with uncalcined pumice, mixed with the same matters as had been added to the brick and calcined pumice of the first flasks.

The next four flasks contained,—the first chalk, slightly moistened; the second, calcareous marl, with alkaline carbonate; the third, an intimate mixture, in the form of bullets, of decanted kaolin and precipitated carbonate of lime; and the fourth, argillaceous earth, taken from one metre below the surface. Of these eighteen flasks, nitrates were found after the experiment in considerable quantity in all those containing the brick, calcined pumice, and ordinary pumice. In the chalk, the pure marl and the marl containing alkaline carbonate, and in the mixture of kaolin and carbonate of lime, traces only of nitrates were found; in the calcined bones, and in the argillaceous earth, none whatever.

This experiment conclusively shows that, without the presence of any acid or ammonia, pure oxygen and nitrogen may combine directly to form nitric acid by contact with porous substances, containing alkaline or earthy matters.

(To be continued.)

On a New Method for the Production of Chlorine, by M. Laurens.

The process proposed by M. Laurens for the preparation of chlorine consists in decomposing chloride of copper by heat. Here is a *résumé* of the operation:—First, prepare

the chloride of copper, either by dissolving the oxide of copper or the native carbonate in hydrochloric acid, or by double decomposition with sulphate of copper, chloride of barium, &c. &c. Evaporate and crystallise the solution of chloride of copper thus obtained, mix it with sand, and dry it absolutely (probably in a reverberatory furnace). Introduce the dried mixture into retorts similar to those employed in the manufacture of gas. If these retorts are of cast-iron, they should be covered with a coating of earth mixed with charcoal, to isolate the metal. The chloride, greatly heated, decomposes into chlorine and sub-chloride.

The protochloride, the residuum in the preparation of chlorine, is not lost; it may be reconverted into chloride by the oxidising action of the air in presence of hydrochloric acid. The reconverted chloride is treated in the way just pointed out; and so the circle of reactions go on indefinitely.

It will be seen that this process corresponds with that of M. Dunlop-Tennant. It is atmospheric oxygen which, by reproducing bichloride of copper in this process, and binoxide of manganese in Tennant's, effects the oxidation of the hydrochloric acid. The advantages of M. Laurens' interesting reaction are the following:—A saving of half the hydrochloric acid, and regeneration of the comburant by a direct and single operation. The objections to the process are the dearness of copper and the many chances of loss of the metal, either as chloride during its decomposition, or of protochloride or chloride in some of the unavoidable removals; moreover, it is to be feared that handling large quantities of chloride of copper the dust arising from it in a chlorine manufactory would be likely to injure the workmen's health. In any case, this interesting process is highly to be recommended for laboratories, for furnishing dry chlorine readily, without the intervention of a fragile and cumbrous apparatus.—*Rép. de Chemie.*

TECHNICAL CHEMISTRY.

On the Induration and Preservation of Stone, by Messrs. Bartlett Brothers and Co., *Camden Town.*

Amongst the many efforts to effect the preservation of stone, we respectfully ask you to chronicle our own in the pages of your journal. It would ill become us to disparage other processes, or attempt to laud our own invention in your columns. We propose, therefore, to confine ourselves to a full description of the invention, the materials we use to accomplish our end, and the behaviour of these materials separately and in combination. Enough has been said in this journal to show, from logical and chemical reasoning, that silica must form a principal feature in all efforts to produce an eligible material for purposes of induration. Silica, then, is the principal material in our process, and that in the form of silicate of potash. Of this material in itself we need say but little; but, lest silicate of soda and potash should here be deemed synonymous, we would anticipate our remarks by saying that in this process they are by no means identical, the silicate of soda producing results both unsatisfactory and valueless The second material is the aluminate of potash. Of this, in the form of an aqueous solution, we find it stated by all chemical authorities to the present time that it precipitates an hydrate of alumina, difficultly soluble in excess of the precipitant; and thus we found it behave after forty-eight hours, precipitating most bulkily in heavy solutions, and as much so in proportion in light specific gravities. We need not say how valueless was such a solution commercially, nor tell the difficulties attending the discovery of a simple remedy, so simple as the determination of the particular specific gravity at which it would not precipitate. The behaviour of the aluminate with water is remarkable, seeing that one atom of alumina held in perfect solution by say three atoms of water should be precipitated by the addition of a fourth, or by the withdrawal of one of the three atoms. Such facts we leave to the investigation of those who may be pleased to pursue them further. Suffice it to say, then, that the aluminate used is prepared from a fused compound of alumina and potash, which product, being highly deliquescent, is easily soluble in water, and so nearly neutral as to contain in its best form of manufacture but two per cent. of free potash.

In the combination of silicate of potash and this aluminate of potash consists the process, the consideration of which affords some most interesting details. When silicate of potash, sp. gr. 1·250, and aluminate of potash, sp. gr. 1·200, are mixed together, an instantaneous decomposition takes place, and the result is a solid mass, consisting of silicate of alumina and some free potash. This hardens with extraordinary rapidity, and is a most beautiful example of the great affinity of silica for alumina. But take a solution of a lighter specific gravity, and we find that decomposition does not instantaneously take place. On the contrary, the liquidity of the two solutions in combination is retained for a time, only, however, proportioned to the quantity of water with which it is diluted. Thus a specific gravity of 1·150 will last as a solution ten hours, while at 1·200 it solidifies immediately. The cause of this arrest of the decomposition—if, indeed, it is arrested—and the peculiar part the water plays in this interchange of elements, will yield a field of interesting inquiry. With the results, however, we have now more immediately to deal; and

Firstly, the time so necessary for manipulation is given in the use of these materials which in themselves secure an insoluble product by their mutual decomposition. Secondly, that the agent and re-agent being mixed in one solution, there can be no fear of the one or the other being in excess or unneutralised, as in the use of acid or second solutions. Thirdly, the product resulting from this combination of silicate of potash and alumina is insoluble in dilute sulphuric and hydrochloric acids. And lastly, if Ansten, Bath, and Caen stone or chalk be pounded, this product will recombine them, thus showing that its chemical affinities are in favour of the material with which it is proposed to impregnate the stone. Finally, in the works of Füch's and the *brochures* of Kühlmann the foreshadowing of this process may be seen; and in the Report of the Commission appointed to investigate the causes of the decay of the Houses of Parliament, there are mentioned, though not in conjunction, the very materials proposed to be used by this process. We trust that our researches in this direction may prove so successful as to benefit the public at large, and afford its quota of like satisfaction to ourselves.

Sugar in the Urine of the Fox.—It will be of some interest to physiological chemists engaged on the hepatine and sugar question, to learn that De Vintschgau (*Sitzungsb. der K. Akad. der Wissenschaften zu Wien*, Bd. lii. s. 523) has found small quantities of sugar in the urine of the fox, a purely carnivorous animal. The method he used to detect it was that of Brücke.

PHARMACY, TOXICOLOGY, &c.

On the Analysis of Stains, supposed to be caused by Blood. by Thomas D. Toase, *Esq., F.C.S., F.S.A., Jamaica.*

It is a matter of the highest importance to know if stains, supposed to be caused by blood, can be correctly analysed; and also if it can be determined what animal the blood came from, but more especially if it is human blood. These questions generally bear reference to judicial cases, and often involve a matter of life or death.

It is the more necessary to examine these questions, as certain authorities have asserted that not only can blood stains be analysed correctly, but that even the animal from which the blood came can be firmly established.

I will examine, one by one, the tests given us by these authorities.

If the spots are upon some fabric, they must be cut out, but if not, they must be carefully scraped off. In either case, they must be placed in some clear water, keeping the spots in the water, but near the surface. If these spots are blood spots, a heavy stream will fall to the bottom of the water. This is the method given by my late much lamented master, M. Orfila, the celebrated toxicologist. I mention this, as Dr. Taylor, in his late work on Medical Jurisprudence, would seem to take the credit to himself of originating this simple mode.

Supposing that the heavy stream falls, there is certainly an indication of blood; but if there is no stream, an indication of the presence of blood is wanting, chemically speaking.

If the heavy fluid is formed, then take the pieces out of the water carefully: draw off the supernatant water with a pipette, so as to leave only what may be presumed to be blood; with care this can be easily managed (Orfila). Put this fluid into six test-tubes, and a portion on a glass slip to be examined later under the microscope; these portions to be tested in the following manner:—

The quantities, of course, are so small that it would be useless to examine the spots for fibrine, important though such an examination would be, if possible. On an average, in a healthy body, blood is said to contain only two parts in a thousand of fibrine. Seeing the smallness of the quantities, the attention of the analyst must be directed to the albumen and the iron. It will be useless to seek for the characteristic colouring matter of the blood (hematosine) after the lapse of some days, these spots being, in all probability, several days old before they pass into the hands of the analyst.

Before examining the tests, I must draw special notice to this fact, in the two tests I shall first mention, the spots must be fresh, as these two tests do not show themselves on blood that has been kept for some time. Indeed, in one case mentioned by Mr. Taylor, some true spots of blood which had been operated upon, refused to answer to these two tests after twenty-four hours in warm weather. I shall, however, mention them:

1st.—If the stains are recent, take a little of the red fluid that has been collected, and mix it with some water; if this fluid dissolves readily in the water, and imparts to it a rich red hue, the colouring matter of blood (hematosine) is indicated. I cannot but consider this test as valueless, not only because freshness is a necessity, but because other colouring matter may produce the same tint when dissolved in water, and the supposed blood-stains may be only stains produced by other colouring matter, not hematosine.

2nd.—To this solution add a few drops of weak ammonia, taking special care to add very little ammonia (a glass rod dipped in a weak solution of ammonia, shaken and dipped in the red solution, will be the safest). If the red solution becomes crimson or green, it is not blood; but if the solution remains unchanged, then the evidence is still stronger that this colouring matter is the hematosine of blood. This is certainly a most valuable test, *if* there are no red colouring matters, other than hematosine, which are unaffected by ammonia.

But I cannot dwell too strongly on the fact, that these two tests, indicating the presence of the colouring matter of blood, require that the stains be fresh.

In the following tests freshness is not necessary.

3rd.—Take some of the thick liquid, collected from the stains; add a quantity of concentrated ammonia, and see if the colour now changes to a brown tint; if so, I think we have reason to suspect iron, but we are far from having established its presence, to prove which we must apply all the known tests for iron, which our small quantities to be tested will not allow. We must, therefore, rest contented with a mere indication. And even should we determine the presence of iron in the stains, that would not prove, of itself, that the stains were blood-stains. It is evident that this test possesses but little value, seeing that we can produce the same reaction from other stains besides blood-stains.

4th.—Boil a little of the red fluid, and see if it coagulates, if the colour is destroyed, and if a flocculent brown precipitate is formed. The coagulation will indicate albumen, but that is all.

5th.—Take the flocculent brown precipitate, filter and dry it, and see if it becomes a black resinous substance, insoluble in water; if so, then add some caustic potash, boil again, and see if a green coloured solution is formed. This would lead us again to suspect iron.

6th.—Now take some of the suspected fluid, add to it some strong nitric acid, and if the fluid coagulates albumen is again indicated.

But I must protest against these tests; they are unchemical and unsatisfactory; we can obtain from them, at most, but indications of iron, albumen, and, if the spots are fresh, hematosine. I have purposely employed the term "indications," for I most emphatically assert, that no chemist has a right to say "such and such is the composition of such a body," if each material composing that body has been determined on the faith of one or two tests, and these tests the very reverse of conclusive; such reasoning could not be admitted in a chemical laboratory. As an analytical chemist, I would not do so in any commercial analysis, fearing a mistake on my part, leading to future exposure by some brother chemist, as in a case I well remember: a chemist had relied on two tests, and on them determined that a certain substance contained lead; another chemist examined the same substance more carefully, and found that it contained bismuth, and not lead. If a chemist dreads the exposure of a mistake, caused by an incomplete analysis of a mere commercial substance, how much more would he fear swearing a fellow creature's life away on mere indications?

For I assert, that to make a complete analysis of a fluid, suspected to be blood, that the iron, the albumen, the hematosine, and the fibrine should each be separated and each examined by all the known tests for each; and

if one test fails, I maintain that the analysis is incomplete, according to laboratory practice.

But there is another important aid, the microscope, which determines the presence and the form of the corpuscles, if present, this is a most valuable test; but it is simply a microscopical test, unsupported by a satisfactory chemical analysis.

I, therefore, come to the conclusion that, considering the small quantity of matter to be acted on, we can only obtain presumptive evidence that blood is the cause of these stains. I must again remind the reader that the determination of these questions may involve a matter of life or death, and that the accused has a right to the benefit of a doubt, the more especially as such an examination as I have just described, made in a chemical laboratory, where only commercial interests are concerned, would not be received.

I am loath to leave this subject without giving a striking proof of how elementary our knowledge of blood is. Fowne's work on Chemistry, a text book in very general use, contains this assertion :—"The colouring matter of blood contains albumen, and coagulates by heat, and by the addition of alcohol; this albumen cannot be separated, and all attempts to isolate the hematine, or red pigment, have consequently failed. From its extreme susceptibility of change nothing is known of it in a state of purity." Now, Muller, in his "Manual of Physiology," says quite the reverse :—"When blood, coagulated by alcohol, is boiled in this re-agent, the hematine is dissolved, and we thus succeed in freeing it from the whole of the adherent albumen."

We have now to determine if human blood, submitted to a microscopic examination, can be distinguished from the blood of any other animal. The circular form of the globules confines our attention to mammiferous animals, to the exclusion of the dromedary and the llama. This subject has already been so satisfactorily discussed by Taylor, that I cannot do better than subjoin the following quotation:—"The only microscopic distinction between the blood of man and domestic animals, consists in a difference in the size of the blood globules. This, however, is only an average difference, for the globules are found of very different sizes in the blood of the same animal. In making use of this criterion, it would be necessary to rely on the majority of the corpuscles seen in a given area, and under the same power of the microscope. The corpuscles in man, the dog, the rabbit, and the hare, are nearly of the same size. In the blood of the sheep and goat, they are smaller than in that of any other animal. According to Gulliver, the measured diameter of the globules in human blood varies from $\frac{1}{2000}$th to $\frac{1}{4000}$th of an inch. From the examination of various specimens of human blood, I (Taylor) have found the average diameter of the globules to be the $\frac{1}{3500}$th of an inch, the maximum size being the $\frac{1}{3000}$th and the minimum $\frac{1}{5000}$th. According to Gulliver, $\frac{1}{4267}$th in the ox. In the cow, according to my measurement, $\frac{1}{4000}$th to $\frac{1}{4200}$th. In the sheep, according to Gulliver, $\frac{1}{5300}$th; according to my measurement, $\frac{1}{5330}$th to $\frac{1}{6000}$th, In the goat, according to Gulliver, $\frac{1}{6866}$th.

"These measurements apply to recent blood, which has not been allowed to dry in animal and vegetable stuffs. In this case a distinction might be made between the blood of a human being and the sheep. When blood is dried on clothing, and it is necessary to extract the corpuscles by means of a liquid of a different nature from the serum, we cannot rely on slight fractional differences, since we cannot be sure that the globules, after having been dried, will ever re-acquire, in a foreign liquid, the exact size which they had in serum. Medical evidence must, therefore, be based, in such cases, on a mere speculation."

Many other considerations might be added, but they appear superfluous after the very conclusive summary I have just quoted.

NOTICES OF BOOKS.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

SIXTH NOTICE.

The processes which have been submitted to the Decay of Stone Committee naturally arrange themselves under two distinct classes, those which have for their object the production of a *mineral* coating upon the surface of the stone, and secondly, those in which the protective agent belongs to the *organic* division, and consists either of bituminous or oleaginous materials alone, or applied in combination with but small proportions of mineral ingredients. In the course of our previous notices we have briefly described all the suggestions and proposals which come within the first or mineral division. It remains, therefore, to proceed to the consideration of some five or six processes in which materials are employed, all of the organic class, but differing very considerably in regard to their probable power of endurance. The chemists on the Committee, in their report of June 17, have been careful in distinguishing between the properties of certain organic substances, which, although they may fall under the same natural division, exhibit, nevertheless, very different characters. In reference to this point, they aptly remark, that "of the second division of processes—namely, those which are only calculated to afford protection of a temporary character—we would recommend that, in addition to the experiments already made in this direction, further trials be instituted of some of the more promising materials of this particular description. This recommendation is based upon the consideration that substances included under the appellation of Organic differ essentially in their powers of resisting the destructive action of the atmosphere. Whoever is acquainted with the nature of organic substances cannot fail to appreciate the different degrees of stability under atmospheric influence exhibited by glutin, gelatin, or starch (which we find enumerated among the proposed protective agents), and by bees' wax and paraffin, not to speak of many of the fossil gums, which exhibit a degree of permanence approaching that of mineral substances. The materials which we would recommend for selection to be tried in comparison with linseed oil are paraffin, bees' wax, and some of the more permanent gums and resins, applied in the form of solutions in volatile solvents."

Of these processes, the first which received application to the Houses of Parliament was the "patent vulcanising and preserving process" of Mr. Daines. This mode of treatment consists in applying a mixture of linseed oil and sulphur, which is merely brushed over the surface of the stone, three or as many as five coats being given according to circumstances. The sulphur does not appear to be employed in larger amount than is capable of dissolving in the oil, so that none is actually laid on the stone in the solid form. A certificate to this effect, signed by Mr. Dugald Campbell, is handed in as part evidence. This document tends to show that the sulphur is not merely deposited on the surface, but penetrates the substance of the stone fully as deep as the linseed oil; that, in fact, no separation of ingredients occurs.

As an indication of the early period at which the Westminster Palace showed the first signs of decay, it is important to note that, the sanction of Sir Charles Barry

having been obtained, Mr. Daines commenced his operations upon the building as far back as the year 1854, "shortly after the execution of the masonry, and when it was quite clean." A comparison of the work coated at that time or soon afterwards with other portions of the exterior not so protected, forms the subject of a favourable report signed, among other architects, by two members of the present committee, by Dr. Ruttledge, and by Mr. Edward Macmurdo, chemist, of the firm Davy, Macmurdo, and Company.

The general appearance of the prepared surfaces of stone is said to be cleaner and brighter than the adjacent untouched portions of the work. In one part only—that first treated—an unsatisfactory discoloration is complained of; this is, however, sought to be explained by the circumstance that "the American potash used in cleaning the surface had been mixed in new oak pails." In reference to this preparatory treatment, we cannot but think that the use of a material which would have a tendency to impart to the stone surfaces a deliquescent character, was highly injudicious, and that such a step would be calculated to prevent that thorough contact and penetration of the stone by the preservative agent which must be the chief aim of this and similar processes. As the only further subject of remark which occurs to us to mention in regard to Daines' process, is the well ascertained property of sulphur, when in a finely divided condition, to undergo oxidation, becoming converted, indeed, into nothing short of sulphuric acid by exposure to the atmosphere. Flowers of sulphur when tested with moistened blue litmus paper, will always be found to communicate an acid reaction, and water filtered through them will usually afford with chloride of barium an immediate indication of sulphuric acid. Now, as the general result of the chemical examination of the efflorescent matters which are constantly forming on the decayed surfaces of dolomite was shown by Mr. Warington (*vide* Mr. Ransome's evidence) to consist of 90 per cent. of sulphate of magnesia, and only small quantities of the sulphates of lime and soda, it must, we think, be in every way an unsatisfactory proceeding to apply to the stone of the Houses of Parliament that substance which when oxidised, is known to be peculiarly active in inducing disintegration. The presence of linseed oil, though it may lessen, is not likely to overcome altogether this tendency of sulphur to undergo oxidation.

A Manual of Chemistry, Descriptive and Theoretical. By William Odling, M.B., F.R.S. Part I. London: Longman and Co. 1861.

SECOND NOTICE.

In a former number we noticed the chief characteristics of Dr. Odling's Manual; we now propose to criticise with greater fulness, not so much the Author's method of handling his subject, as some of the more novel or striking of his views and statements,—those, in fact, which point out the work as no ordinary production. The Author, indeed, fully acknowledges his obligations to previous writers who have adopted the Unitary Notation; such, for instance, as Laurent, Gerhardt, Kekulé, and Hofmann. While he has elaborated, supplemented, and modified the general theory of the first-named chemists, he has applied several of the happy suggestions of the Belgian Professor to that department of the science generally known as inorganic chemistry. But, after all, the work is marked by great originality, and we heartily welcome the first instalment of it as a most important addition to the chemical literature of the country. The book is so well and clearly written, and is evidently the result of so much honest labour and careful thought, that it is very difficult to discover any flaw at all in it. If we were called upon to point out what we considered defects, we could cite nothing but a slight vagueness occurring occasionally in the description of reactions, or of manufacturing processes. The book also is scarcely suited for the beginner; it plunges too precipitately into the arcana of the science. But the system of the book is so truly scientific, the style so attractive, and the advocacy of the new notation so earnest and consistent, that the most practised chemists cannot fail to be interested in its perusal.

The method of describing the elements, according to their relations to the typical element, hydrogen, is now applied to general chemistry by Dr. Odling. Professor Kekulé had already shown how admirably it was calculated to throw light upon the constitution of many organic bodies, hitherto regarded as anomalous. Professor Odling has found suitable places for many compounds generally viewed as of uncertain formulæ or doubtful relationship. For example, some of these are now viewed as aldehydes, and as bearing the same relations to their respective oxacids as common aldehyde bears to acetic acid. They are for the most part known in the form of chlorine substitution-products, and although these have been in some cases obtained from the original aldehydes by replacement of chlorine for hydrogen, yet they are usually formed by indirect processes. When the chlor-aldehydes react with water, a characteristic result follows. They exchange Cl for the compound radicle, HO, so as to form HCl and the normal oxacids to which they correspond. Among such aldehydes the following bodies occur:—

Sulphurous chlor-aldehyde, (Bichloride of thionyle).	Cl_2SO
Sulphuric chlor-aldehyde, (Bichloride of sulphuryle).	Cl_2SO_2
Phosphorous chlor-aldehyde, (Terchloride of phosphorus).	Cl_3P
Phosphoric chlor-aldehyde, (Oxychloride of phosphorus).	Cl_3PO
Sulpho-phosphoric chlor-aldehyde, (Sulpho-chloride of phosphorus).	Cl_3PS

The radicles thionyl and sulphuryle appear again in the bodies known as thionamide and sulphamide:—

Thionyle-diamine	$(SO)''H_4N_2$
Sulphuryle-diamine	$(SO_2)''H_4N_2$

The curious substance discovered by Williamson, namely, chlorhydrosulphurous acid, $HClSO_2$, is viewed as intermediate between the corresponding chloraldehyde and the biatomic acid, the sulphurous.

Nitric chloraldehyde is $ClNO_2$ and may of course be viewed also as chloride of nitryle. Nitrous chloraldehyde is ClNO, and also takes its place among the other azotyle compounds in the following series:—

Chloride of azotyle, (Chloro-nitrous gas).	(NO) Cl
Bichloride of azotyle, (Chloro-nitric gas).	$(NO)Cl_2$
Sulphate of azotyle,	$(NO)HSO_4$
Nitrous acid,	(NO)HO
Nitrous anhydride,	$(NO)_2O$

We find a judicious view of compound radicles which the author describes as not necessarily existent in bodies, but as molecular groupings capable of being transferred from one body to another. By accepting this modified doctrine we shall still be able to regard bodies as related to one another in constitution, when they are known to be related to one another in derivation and behaviour.

By an enlargement of the ordinary idea of double decomposition, the author is enabled to refer most chemical changes to that symmetrical mode of action. Such changes are the direct union of two elements—the breaking up a compound into its elements—and the liberation of a single element in the free state.

The author illustrates the relation of seriated heterology

by the following series, among others : we cite those not containing carbon :—

H_2SO_6	(wanting)
$H_2S_2O_6$	Dithionic acid
$H_2S_3O_6$	Trithionic acid
$H_2S_4O_6$	Tetrathionic acid
$H_2S_5O_6$	Pentathionic acid
HCl	Hydrochloric acid
HClO	Hypochlorous acid
$HClO_2$	Chlorous acid
$HClO_3$	Chloric acid
$HClO_4$	Perchloric acid.

Professor Odling found that it is possible to pass from the first to the second member of this series by a process of direct oxidation.

NOTICES OF PATENTS.

486. *Distillation of Bituminous Substances.* J. Young, Limefield, Edinburgh. Dated February 25, 1861.

This invention has reference to improvements in apparatus for distilling the Boghead minerals, bituminous coals, and other bituminous substances, and consists in the arrangement of a series of vessels constructed for this purpose, of stoneware, brick, or other suitable material, communicating with each other, and placed side by side, or in a circle, as may be most convenient. These vessels having been filled with the bituminous substance to be treated, are connected with a steam-boiler, and a jet of steam passed through the whole in succession, at a sufficiently high pressure and temperature for ensuring the proper distillation of the coal. The oils generated during the process are drawn off at intervals from the stoneware vessels, and when they have accumulated in sufficient amount and the charge in the first vessel is exhausted, this is disconnected and the jet of steam brought to bear directly on the second, while another newly charged with coal is made the last in the series. The process is, therefore, a continuous one, and the gaseous products of the distillation are allowed to pass off from that vessel which at the time happens to furnish the last outlet.

The improved arrangement of apparatus here described is calculated to facilitate the manufacture of mineral oils of the paraffin class, for which Mr. Young has long been celebrated.

488. *Oils.* C. Corroy-Reonault, Margaret Street, Cavendish Square, London. Dated February 25, 1861. (Not proceeded with.)

For the purification and refining of such oils as are usually manufactured by processes of distillation, the inventor treats the crude material with one of the following substances, employed in the state of powder,—viz., charcoal, brick-earth, clay, talc, steatite, chalk, slate, or coal-ashes. After being intimately incorporated with any of these, the impure oil or resinous substance is submitted to distillation, when the glutinous, gummy, or otherwise prejudicial matters are retained in the retort, and a partially-refined product passes over. It is proposed further to subject this to a second process of distillation from powdered quick lime, caustic soda, and generally small proportions also of chloride of lime, and one of the class of materials employed in the first process. A third treatment, similar in nature to the second, may sometimes be resorted to with advantage. The process is applicable likewise to the clarifying, decolorisation, and disinfection of oils and fats already manufactured.

The system of treatment here defined is undoubtedly capable of effecting great improvement in the quality of many crude oily products, as, for instance, those derived from Irish peat and the inferior descriptions of mineral oil. It must be borne in mind, however, that processes involving the employment of large quantities of bulky, porous materials, and repetition of treatment, must necessitate great loss in the successive stages of the process of purification.

513. *Glue or Composition suitable for Covering the Caulking of Ships, &c.* W. J. Hay, Southsea, Hampshire. Dated February 28, 1861.

The present is an improvement upon a former invention, for which letters patent were granted to Mr. Hay on February 1, 1858. The object now accomplished is the preparation of a material more elastic than heretofore, and devoid of the unpleasant odour usually attaching to these compositions. Instead of crude naphtha and rough creosote as solvents for the asphalte and caoutchouc, the inventor prefers to employ resin oil, and he makes the new composition of the following ingredients melted together: —The several varieties of natural bitumen or asphalte, vegetable pitch or tar, and resin oil are used with or without caoutchouc. The patentee claims, also, the employment of oil of turpentine, wood naphtha, or any spirit or essential oil.

The material here referred to is evidently a description of "marine glue," the manufacture of which, according to the original specification of Mr. Jeffery, must be seriously affected by the high price which shellac has commanded for some time past in the drug market.

514. *Improvements in the Treatment of Certain Ores containing Metals, and in Obtaining Products Therefrom.* R. Laing, Ince, near Wigan. Dated February 28, 1861.

This invention relates to the economical use and application of the gases which are allowed to escape from the leaden chambers in the ordinary process of manufacturing sulphuric acid. It is proposed to employ these waste gases for the purpose of rendering soluble the copper and other metals contained in the roasted pyrites left as a residual product after the extraction and conversion of its sulphur into sulphuric acid in the chambers. By washing with water, the soluble metallic compounds may then be recovered.

This proceeding is likely to meet with advantageous adoption in those vitriol works where iron pyrites is employed as the source of sulphur.

537. *An Ointment for the Cure of Sores.* C. Stevens, Charing Cross, London. A communication. Dated March 2, 1861.

This ointment is composed of the following ingredients :— Litharge, one lb.; strong vinegar and olive oil, of each about a pint. These materials are first well incorporated, and then boiled till they form a thickish paste. It is recommended to apply the ointment by spreading on a surface of bibulous paper.

The patent remedy thus procured would be an intimate mixture of Goulard-water, glycerine, and common lead-plaster.

529. *Improvements in Distilling and Rectifying, and in Apparatus employed therein.* M. Henry, Fleet Street, London. A communication. Dated March 1, 1861.

According to this invention, the liquids to be distilled are fed continuously into a vessel or chamber in which they undergo distillation, and whence they run out as soon as they have parted with their volatile portions, the requisite degree of heat being obtained by an arrangement of steam pipes coiled within the still, and an outer steam jacket or casing. The inventor prefers the use of shallow vessels exposing large surfaces of liquid, by which the rapidity of distillation is promoted. A number of vessels contrived as above may be arranged at different

levels, and the liquid and steam caused to circulate from one to another, so that distillation may be carried on at various temperatures, and products of different degrees of volatility obtained. A thermometer is appended to each vessel in the series to indicate the temperature.

The arrangement of distilling apparatus here described is extremely ingenious. A further improvement would consist in passing the exit steam pipe through a supplementary tank or vessel wherein the liquid might be slightly warmed before actually entering the still.

554. *Glass.* T. Petitjean, Brydges Street, Covent Garden, London. Dated March 5, 1861.

Amongst other claims for improvements of a mechanical nature in the apparatus employed for glass-blowing, the inventor enumerates the use of charcoal as a fuel especially adapted to these purposes, and, moreover, generally applicable to the manufacture of glass.

The bulky nature and quick-burning properties of ordinary wood charcoal are difficult to reconcile with the statement of advantages referred to in this specification.

Grants of Provisional Protection for Six Months.

1927. George Fowler Jones and James Jones, York, "Improvements in apparatus for protecting and arranging water-pipes, and withdrawing water therefrom, and preventing injury thereto by frost."

1935. William Edward Newton, Chancery Lane, London, "An improved process for producing colouring matters or pigments from manganese."—A communication from Paul Morin, Rue St. Sebastien, Paris.—Petitions recorded August 3, 1861.

2146. James Duncan, Greenock, Renfrewshire, N.B., "Improvements in the manufacture of sugar, and in the apparatus employed therein, also in the apparatus employed in re-burning animal charcoal." — Petition recorded August 28, 1861.

2176. Edward Joseph Hughes, Chancery Lane, London, "An improved apparatus for collecting the gases which escape from furnaces."—A communication from Mr. Emil Langen, Sieburg, Prussia.

2178. William Armand Gilbee, South Street, Finsbury, London, "Improvements in the process and apparatus for the manufacture of steel."—A communication from Jules Paulis, Brussels.

2233. Edward Harrison and Thomas Shuttleworth Yates, Oldham, Lancashire, "A certain compound or certain compounds to be used as a substitute for gunpowder."

2238. Nicholas Doran Proby Maillard, Dublin, "Improvements in the material and preparation of the material and apparatus for making potash, pearlash, and caustic potash of commerce."

2377. Joseph Jacob, Golden Square, London, "Improvements in the mode of and apparatus for obtaining and treating hydrogen gas, and the application thereof to various purposes, parts of which improvements are applicable to the manufacture of iron and steel."—A communication from Carl Preisenhammer and Carl Weniger, Zöptau, Austria.—Petition recorded September 23, 1861.

2441. Pierre Alexis Francisse Bobœuf, Paris, "The preparation and application of certain new hemostatic and antiseptic agents."—Petitions recorded September 30, 1861.

2477. Charles Husson, Nantes, France, "An improved process for silvering looking-glass in piles of several sheets superposed without interruption, which process consists in the use of a chemical powder."

Notices to Proceed.

1457. Henry Du Mont, Rue du Rivoli, France, "A photographic apparatus having for object to reproduce the successive phases and shiftings of a motion."

1580. John Fisher Williams, Queen Square, St. George-the-Martyr, London, "Improvements in compounds of india-rubber and gutta-percha with other substances."—Petitions recorded June 19, 1861.

1638. Samuel Alexander Bell, Epping Villas, Stratford, Essex, "Improved machinery or apparatus for arranging and securing splints, tapers, or matches in frames preparatory to dipping."—Petition recorded June 26, 1861.

2100. Louis Marino Casella, Hatton Garden, London, "Improvements in mercurial thermometers." — Petition recorded August 22, 1861.

CORRESPONDENCE.

Deodorisation of Sewage.

To the Editor of the Chemical News.

Sir,—I have read with great interest the information which from time to time you have given to your readers on the highly important subject of the deodorisation and utilisation of sewage. In a late number you report the successful application of carbolic acid as a disinfectant.

Up to the present time I believe that lime is the substance that has been most extensively used for the disinfection of sewage, but I presume it is found of little use except in very great excess.

I wish to inform you of a fact which has come repeatedly under my observation, which seems to prove to me that lime is not suitable for the disinfection of sewage. One part of my business has to do with the melting down of large quantities of animal fats, which is done by means of steam and sulphuric acid.

Necessarily there is a large quantity of refuse left behind when the fatty matter is separated. Now, to utilise this refuse and also to make it into a solid artificial manure by drying, I found it necessary to neutralize all the free SO_4H, which I did by adding a small quantity of lime. From the fat being melted with the least possible quantity of SO_4H there is very little free acid. Now, whenever the whole of the acid is neutralised and lime is in excess, then the mass begins to stink, and gas begins to come off. I should say that this occurs in about twenty-four hours, when the mass has been slightly heated by the steam-boiler flue passing round the iron pan or boiler in which it is placed.—I am, &c. Technologist.

Manchester.

On the Estimation of Alcohol in Wine.

To the Editor of the Chemical News.

Sir,—In reference to a letter which appeared in the last Number of the Chemical News, I trust I have quite as keen a sense of honour and propriety as "Suum Cuique" in acknowledging the rights and privileges of others, and beg to assure that gentleman that he is greatly mistaken in supposing that I took the *initiative* for those experiments from another person, never having seen Mulder's work by Dr. Bence Jones, nor had I any recollection of the extract and discussion appearing two years ago in the Chemical News: therefore, if my experiments tally with Mulder's, it was the result of circumstances, and from close personal observation, that I derived that knowledge, having been requested by a wine-merchant, who complained of the discrepancies and irregularities of the Excise charges for duty, to institute a series of experiments, in order that he may be the better prepared in future to seek redress from the proper authorities—the same quality of wine being differently charged at two different ports. I commenced, of course, by distillation; and with the view of knowing how far to carry that process, so as to ensure

the entire elimination of the alcohol, I attached a graduated scale to the retort, and noted the precise moment when oiliness ceased to form in the tube as stated. Observing that it was just at *half* the bulk of the wine used, I had no difficulty in getting at the specific gravity and strength of the alcohol either as gain or loss, since, if the one was ascertained, the other, *i. e.* the extractive matter, was also known, and *vice versa;* and, to shorten the process, preference was given to its estimation as loss.—I am, &c.

John Horsley.

Nitrates in Water.

To the Editor of the Chemical News.

Sir,—I see that in your last Number you published the results of my analysis of a water from Tewkesbury, which contained a very extraordinary proportion of the nitrates of lime and potassa. I was so astonished at meeting with such a large quantity of those salts, particularly the latter, that I felt desirous of learning whether it was really a natural water. I learned that the well was situated on the site of a demolished inn, and was very near where the stables had formerly existed, that the water had been of fair quality for a long time, but all at once had changed its character; it is therefore most probable that some accidental waterfall had caused the oxidized products of the former stable to overflow into the well.

I am, &c.

William Herapath, F.C.S., &c.,
Professor of Chemistry, Bristol, Old Park.

Bleaching Wood.

To the Editor of the Chemical News.

Sir,—I have some wood which, naturally nearly white, has, through neglect in drying, become brown and otherwise stained. The sap not having been evaporated, has filled the pores of the wood with coloured matter. I have tried various chemical agents to remove this colouring matter, but in vain, some of them make the matter worse.

Can any of your readers suggest any substance that may possibly bleach this wood so as to make it nearly white, or if not, tell me of any good work on bleaching which would be likely to give me the desired information?—I am, &c.

W. W. C.

Relations between the Elementary Equivalents.

To the Editor of the Chemical News.

Sir,—On comparing the equivalents of Cs, Rb and K, it will be found that they form one of those remarkable proportional triads of which K, Na and Li, I. Br and Cl. are familiar instances.

$$\frac{\text{eq. Cs} + \text{eq. K}}{2} = \text{eq. Rb nearly.}$$

$$\frac{128{\cdot}4 + 39{\cdot}3}{2} = 83{\cdot}85.$$

It is an interesting fact that there should exist two of these proportional triads amongst five elements whose properties so much resemble one another.—I am, &c.

Charles W. Quin.

Derivation of Names of Elements.

To the Editor of the Chemical News.

Sir,—I cannot trace the origin or meaning of the words "iron," "ferrum," or "zinc;" can any of your readers help me? Is "manganese" a mere transposition and repetition of the word "magnesia," with the compounds of which those of manganese were confounded till 1740? The signification of the rest of the names of the common elements seems tolerably evident.—I am, &c.

A Tutor.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Constitution of the Acids of Phosphorus.—M. Lieben speculates (*Annales de Chimie et de Physique*, t. lxiii., p. 92) that, setting pyro-phosphoric acid out of the question for the present, all the other acids of phosphorus may be considered as derivatives of a triatomic radical *phosphoryle* $P\Theta$. Thus, he represents phosphorous acid as

$$\left.\begin{matrix} P'''\Theta, H \\ H_2 \end{matrix}\right\} \Theta_2$$

and hypophosphorous acid as

$$\left.\begin{matrix} P'''\Theta, H_2 \\ H \end{matrix}\right\} \Theta$$

These formulæ, he says, account for the fact that both of the above acids contain 3H, two of which in phosphorus and one in hypophosphorous acid are replaceable by metals. The theory of Berzelius, which represented the former as $3HO, PO_3$, and the latter as $3HOPO$, did not satisfactorily explain this fact. In metaphosphoric acid, the author considers that the 2H which in hypophosphorous acid are combined with $P\Theta$ are replaced by Θ. Thus, the formula for metaphosphoric acid will be

$$\left.\begin{matrix} P'''\Theta, \Theta \\ H \end{matrix}\right\} \Theta$$

M. Lieben believes that pyrophosphoric acid is tetrabasic, and thinks that until experiment has revealed more of the nature of this acid, it will be useless to propose a rational formula.

Another Chrome-Green.—Bichromate of potash heated with phosphate of ammonia forms, according to M. Guignet (*Bulletin de la Société Chimique de Paris*, No. 4, p. 76), an insoluble metaphosphate of chromium, which is not affected by a red-heat. A slight excess of the phosphate of ammonia must be employed. The same phosphate is obtained when the bichromate of potash is calcined with acid phosphate of lime. M. Guignet doubts its usefulness as a pigment, the colour not being sufficiently intense.

II. ORGANIC CHEMISTRY.

Synthetic Formation of a Saccharine Substance.—M. Boutlerow found (*Bulletin de la Société*, No. v. p. 84) that when dioxymethelene is boiled with an excess of lime or baryta water the mixture, which at first is colourless, quickly becomes yellow, and soon passes to an intense brownish-yellow. The odour of dioxymethelene disappears at the same time, and a smell like that of burnt sugar is produced. No gas is evolved during the reaction. When the lime water is added slowly, the mixture being kept near the boiling point, and stopping when the colouration takes place, a neutral solution is obtained, in which carbonic acid causes no precipitate. Evaporated at first on a water bath, and finishing under an air-pump receiver, a thick, yellowish, syrupy substance is obtained mixed with some crystals. Treated with absolute alcohol, the uncrystallizable substance is removed, and a white crystalline powder is left. This the auther found to be formiate of lime. The alcoholic solution evaporated under the air-pump left an extract smelling like syrup prepared with burnt sugar, and tasting like liquorice juice, but acid to litmus. When heated on platinum foil it behaved like saccharine substances, but left a calcareous ash. It reduced the cupro-potassic tartrate even in the cold, and instantly when heated. Like the sugar of mannite, it had no rotatory power. The solution did not appear to ferment with yeast, but as the experiment was made with a very minute quantity of the substance, the author does not consider it decisive. Boutlerow made two analyses of the substance, but the results did not agree well. He considers, however, that in its composition the new substance approaches the bodies which mannite and some of its congeners furnish in losing one molecule of water, and

therefore he names it provisionally *methylenitane*. As the first example of the formation of a substance having many of the characteristics of a true sugar, by means of the more simple compounds of organic chemistry, the production of methylenitane, says the author, is a remarkable fact. Further researches will no doubt soon enlighten us more on the subject, so we leave for the present the author's speculations on the formation of the body, and the analogies with other reactions.

MISCELLANEOUS.

SCIENTIFIC NOMENCLATURE.

The following is extracted from a letter addressed by "C. W. M." to the *Athenæum*:—

Had Milton lived in our days, and studied the "ologies," I think it would have been to them, and not to the clannish names of the North, that he would have gone for illustrations in his Sonnet on the book called "Tetrachordon." Surely, that hard names are the curse of modern science, must be admitted alike by the ignorant and the learned.

Science is not for the idler. No man who has the industry and ambition to become a scholar will grudge reasonable pains bestowed on the language and classification of his subject. Much force, however, lies in the word "reasonable." In many branches of study, but especially in the sciences of observation, the demands made upon the student exceed, as I think, all reason. Mineralogy, organic chemistry, zoology, and physiology are all overdone with technical words, while botany (the ladies' science) is the very abyss of hard names. This might be tolerated if the names were final. But no systematic nomenclature, which is to conform to theory, ever can be final; for the theory itself must change with advancing knowledge. It seems to me that this common character of all theories has been much lost sight of by the inventors of names. Hence it is that to make ourselves acquainted with the results obtained by previous observers, we have to master in each science, not one set of names, but many systems. In botany, it would appear that no one thought he had done useful work unless he had added something to the already overwhelming mass.

In chemistry, the researches of previous years have led to the substitution of name for name, and symbol for symbol, one after another, so many deep that one does not know the "right" appellation of wood-naphtha, or how to ask for a liquid which used to be sold as "spirits of salts," and was *sometime* (as the epitaphs say) muriatic acid, hydrochloric acid, chlorhydric acid, and lately, according to a chemical reformer, hydra-chlora. Sulphates are called thionates by the organic chemists, who run up the Greek numerals until they get to *penta*thionates, and I certainly thought that the acme of descriptive nomenclature had been reached in "methylethylamylophenylammonium," until I found a recent author proposing to substitute for it a word three syllables longer by way of simplification: I forget exactly how he spelt it.

Is systematic nomenclature a necessity of systematic investigation? I think not. But as the consent of authorities seems to be, in practice, at least, against me, I can only venture to propound the question for discussion, and to state reasons for my own opinion. The present opportunity is a particularly favourable juncture for this discussion, because most of the sciences of observation show symptoms of a change in fundamental ideas.

The applications of mathematical physics to chemistry—of chemistry to the functions of animal and vegetable life—the use everywhere of improved optical methods, among which I may mention spectral analysis and examination by coloured or polarised light,—and, more than all the increasing tendency to view Nature as one whole, and the increasing power to perceive universality in her laws—are threatening a complete and immediate disruption of all our existing theories.

And what is a theory? Our lexicon tells us it is a way of seeing—a mode of viewing. No mathematician, no accurate reasoner, ever thinks of a theory as being true, even potentially. It is a mode of viewing the truth, changeable with our point of view, and falling short of the truth by just so much as our limited reasoning falls short of the infinite variety and complexity of the universe, which we can no more grasp in its material than in its abstract form. The finite cannot comprehend the infinite.

These observations are trite; but it is just for the want of noting them that we are encumbered with the flood of names. These have been invented, and grouped, and changed, and re-grouped, and systematized, by each new theorist, as if his theory not only embraced the truth, but were the truth. Here and there some great man, like Linnæus, saw the real meaning of his doctrine, as a guide to generalization; and of his system, as an index to his facts. But he wrote only for the learned, and those who explained his system popularly inflicted his nomenclature on the student, but failed to render his idea.

It is a good thing for an objector to be able to point out a remedy. A good thing, I say, but not a necessary thing. A cook who has spoilt the dinner cannot expect his master to tell him how he should dress it; and an instructor, whose teaching is obviously bad, cannot expect a student to show him his business. Improvements can only be carried out by those who are thoroughly conversant with the details. An outsider can only indicate general principles, and give general advice. I shall content myself with suggesting the following negative rules:—Never invent a name for a thing which already possesses an exclusive one. Never alter an individual name to accord with any theory. Even if a name be not exclusive, do not distinguish, until absolute necessity arise. Look upon individual names as subjects for certainty and fixity; but upon systems as provisional modes of grouping them. Never treat as fact what is merely the consequence of a theory.

I do but ask of the botanists and chemists to follow an example already set them by mathematicians on the one hand, and by men of business on the other. What is an old treatise on botany or chemistry worth now? But the old mathematicians are still profitably read by rising men—indeed, a man can do but little unless he does read them. One has certainly heard of libraries so neatly packed that, like a new plant in a botanical genus, a new book revolutionized the whole arrangement.

Soapstone of Mylos, an important article of commerce in Turkey and Russia, where it is used as soap, has been analysed by M. Landerer, the result being—silex, 63; alumina, 23; water, 12; and sesquioxide of iron, 1·25. This mineral is of a greyish colour, and has schistose fracture. It can be cut into shavings, and adheres a little to the tongue; softens in water, dissolving gradually in it; and afterwards becomes white and greasy to the touch. It becomes grey again after desiccation.

ANSWERS TO CORRESPONDENTS.

H. Mulcaster.—The second lecture is not yet delivered. Indeed, we do not think it was intended to give more than one.

A. O. Z.—Consult Knapp's Technology, published by Baillière.

An Idea.—There is no reward offered by Government. Inventors must take care of their own interests. The duties of the committee are simply to get all the information possible and to make the best use of it.

American Gas Light Journal.—Received. The exchange shall be sent.

W. Stevenson.—Received.

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On the Analysis of Feldspar, Kaolin, and Clay,[1] *by M.* H. SAINTE-CLAIRE DEVILLE.

1. **Treatment with Soda.**—The experiments which I have already performed on this subject suggested to me the idea of attacking the powder of Orthosen feldspar, clay, and kaolin by a concentrated lye of caustic soda the prolonged digestion effects a kind of solution of these substances in the form of a thick turbid syrup. When this is poured into water, there is produced a true decomposition, similar to that of bismuth salts. The syrupy matter, may, in fact, be looked upon as a hydrated and strongly alkaline aluminous glass, which is split up into two parts by the action of water: the soluble portion is a silicate of soda without a trace of alumina; the insoluble part is a double silicate of alumina and soda of a constant composition, which gave me the following results upon analysis:—

Silica	44·6	6
Alumina	26·4	3
Lime	0·4	
Soda	14·9	1
Potash	1·0	
Water, by difference	12·7	3
	100·0	

The water is rather low, and its proportion only corresponds to 2·8, instead of to 3; but the reason is that these substances cannot dry in the air without losing their combined water in the manner of zeolites.

It is remarkable that the same result is always obtained when we treat by digestion in soda either a silico aluminous material with an excess of alumina as bauxite, or a substance with an excess of silica as feldspar. In the first case there is dissolved an aluminate of soda without a trace of silica; in the second case there is dissolved a silicate of soda with a trace of alumina, the residue being the same in both cases. The same product is obtained, perhaps with more certainty, by evaporating the concentrated alkaline solution to dryness, and slightly calcining the residue. In any case a tolerably large excess of alkali must be employed. The silicate insoluble in water is, it must be understood, soluble in acids. Clays and kaolin behave in the same manner when treated with the caustic lye.

2. **Treatment with Hydrofluosilicic Acid.**—The solvent power which hydrofluosilicic acid[2] [$2Si Fl_3$. $3H Fl$] has upon alumina is considerable, and exerts itself instantaneously. I did hope that I should be enabled by its means to remove from clay all the alumina, and investigate the condition of the residuary silica in respect to its solubility in weak alkalies, which would be of interest in relation to the constitution of the clay contained in hydraulic lime nodules.

It is seen, indeed, from the above observations, that the alumina prevents the solution of nearly double its weight of silica (in the proportion of $\frac{44·6}{26·4}$) when the mixture of the two substances in the hydrated state is placed in contact with an alkali which would dissolve each of them separately. But an unexpected reaction takes place when weak hydrofluosilicic acid, such as is always used, is placed in contact with ignited alumina. There is at first formed a neutral fluosilicate of alumina —$2Si Fl_3$. $Al_2 Fl_3$. Then, when an excess of alumina is added, and the digestion prolonged, the fluoride of silicium is decomposed, silica is deposited, and there is formed hydrated and soluble fluoride of aluminium: $Si Fl_3 + Al_2 O_3 = SiO_3 + Al_2 Fl_3$.

The presence of fluosilicate of alumina is shown by filtering the acid liquid which has stood over the alumina (I have always employed alumina obtained from the ignition of ammonia-alum), and by pouring into it chloride of sodium, the almost insoluble fluosilicate of soda is precipitated, and hydrochlorate of alumina is formed, whence the alumina can be precipitated by ammonia. Upon washing and re-dissolving this, no residue of silica will be perceived when the hydrofluosilicic acid and the alumina have been mixed in the proper proportions. The same reaction takes place between kaolin and hydrofluosilicic acid. It is, therefore, perfectly useless to employ pure alumina for the experiments which I have just described: kaolin answers the purpose quite as well, and, when it is free from iron, products of great purity are obtained. However, as kaolins always contain a little feldspar, and as this is readily attacked by hydrofluo silicic acid, a little potash gets into solution.

Warm hydrofluosilicic acid has a slight acid odour which immediately disappears when kaolin in excess is added to it; the saturation is complete when the odour of clay, which is somewhat alkaline, is apparent in the liquid. There then remains no more hydrofluosilicic acid in solution, but only hydrofluate of alumina, or hydrated fluoride of aluminium.

But before this transformation takes place, and when the liquid is still strongly acid, if strong alcohol be added to it an oily matter precipitates, which soon solidifies by crystallisation, and which is a kind of hydrofluoaluminic acid. It is composed of

		Calculated.	
Fluoride of aluminium	65·4	$3Al_2 Fl_3$	66·2
Hydrofluoric acid	10·5	$2H Fl$	10·4
Water	24·1	$10HO$	23·4
	100·0		100·0

If the acid liquid is evaporated, instead of being treated with alcohol, acid is evolved, and a crystalline substance remains, which, after being washed in boiling water and dried in the air has the following composition:

[1] *Annales de Chim. et de Phys.*, lxi. p. 326.

[2] It would be better to employ the formula of M. de Marignac, $Si Fl_2$, HFl; but as chemists are not yet accustomed to it I will continue provisionally to make use of the old formula, which, however, should be abandoned, as the new one is simpler and more rational.

			Calculated.
Fluoride of aluminium .	59·0	$2Al_2Fl_3$	60·8
Hydrofluoric acid . .	8·8	Fl H	7·1
Water	32·2	10HO	32·1
	100·0		100·0

The slight difference which exists between the calculated hydrofluoric acid and that found by experiment is manifestly due to this product being contaminated with the preceding compound, which is a little richer in hydrofluoric acid.

Finally, if dilute hydrofluosilicic acid is completely saturated with excess of alumina or kaolin, a liquid is obtained which, during evaporation, does not liberate acid, and has a faint alkaline odour; it deposits in proportion to the degree of concentration a crystalline powder, which, when dried by artificial heat, loses a little water, and possesses the following composition:—

			Calculated.
Fluoride of aluminium .	59·7	Al_2Fl_3	57 3
Water	40·3	7HO .	42·7
	100·0		100·0

It is a hydrate, the composition of which, varying slightly with the degree of desiccation, should be represented by the formula $Al_2Fl_3 . 7HO$, having regard to the ease with which it loses water upon the slightest application of heat.

All these compounds are free from silica, and resolve themselves at a red heat into fluoride of aluminium, which can be volatilised in a platinum crucible at a red white heat. This operation, which cannot be effected without the intervention of atmospheric oxygen, is never quite complete, in that there is always obtained in the platinum crucible a slight residue of alumina often crystalline.

It is remarkable that fluoride of aluminium, so insoluble in water, so perfectly unattackable by acids, presents itself under these circumstances in the form of a hydrate dissolved in a perfectly neutral liquid. We may imagine, to explain this fact, that there is a hydrofluoaluminic acid of the composition $Al_2Fl_3 . 3HFl$, analogous, consequently, to hydrofluosilicic acid, and of which cryolite, $Al_2Fl_3 . 3NaFl$, would be a neutral salt, as well as the potash cryolite $Al_2Fl_3, 3KFl$, which may be prepared by pouring into a potash salt a solution of alumina in hydrofluoric acid.

In this case the soluble fluoride of aluminium would be simply a neutral fluoaluminate of alumina (making use of the old nomenclature used for the fluosilicates), $Al_2Fl_3 . Al_2Fl_3$, or the hydrofluo-aluminic acid, $Al_2Fl_3 . 3HFl$, in which each equivalent of hydrogen is replaced according to the ordinary law for the formation of neutral alumina salts, by $\frac{2}{3}$ equivalent of aluminium.

As to the hydrofluo-aluminic acid, it may be prepared by dividing a certain quantity of hydrofluoric acid into two equal portions, saturating one of them with alumina and mixing.

The preceding analyses have been performed in the following manner:—Place the weighed substance in a weighed platinum-boat, and introduce this into a small tube of green glass, drawn out at one end and closed at the other with a cork, through which a glass tube passes. Pass through it a current of dry hydrogen and heat the boat and the tube to a temperature of 400° or 500° C. with a spirit or gas flame. Water and hydrofluoric acid are evolved, which strongly attack the glass. Upon weighing the boat after the operation, the loss gives the water and hydrofluoric acid, the weight of the residue giving the fluoride of aluminium. This should be almost entirely volatile at a white heat.

In the same boat weigh a fresh quantity of substance which is mixed with seven or eight times its weight of pure litharge fused and powdered. Weigh the whole and replace the boat in the glass tube, through which a current of dry nitrogen must be passed (for the apparatus to produce nitrogen in analyses, see *Annales de Chimie et de Phisique*, third series, vol. xxxv., p. 442); heat the mixture without fusing the litharge, and water only is evolved. The glass tube, if new, should not be attacked. Weigh after the operation. The loss of weight gives the water of crystallisation in addition to the water formed at the expense of the oxide of lead, which is transformed into fluoride, and of the hydrofluoric acid, the fluorine of which combines with the lead. With these two estimations of loss, and by means of two equations of the first degree, the composition of the substance analysed can be obtained. Let a be the loss in hydrogen, b the loss in nitrogen, and in contact with the oxide of lead we have,—

$$x + y = a$$

$$\frac{9x}{20} + y = b$$

in which x represents the hydrofluoric acid, and y the water. It is evident that the quantities of hydrofluoric acid will be proportional to $a - b$, and that when $a = b$ it is nothing. This happens whenever the neutral fluoride of aluminium is analysed.

I have obtained in these analyses very fine specimens of fluoride of aluminium. It is, indeed, the most economical and quickest method of obtaining this beautiful substance.

It may also be prepared very easily in the amorphous state by fusing a mixture of equal equivalents of cryolite and dry sulphate of alumina. In this manner are obtained sulphate of soda and fluoride of aluminium, which may be separated by water. The fluoride is then distilled in a tube of gas carbon in a current of hydrogen. In this way Captain Caron and I have procured the fluoride of aluminium, with which we have reproduced in the dry way some artificial minerals. M. Damour and I have likewise obtained it by heating wavellite to red-whiteness.

I have, in particular, succeeded in obtaining it in transparent crystals, which have enabled me to observe their influence on polarised light. I was much surprised to see these crystals, which I took to be cubic, sensibly rotate the light between two Nicol's prisms. I remeasured the angles, and found that they were not right angles, but equal to 88·20° or 88·30°. This was rather difficult to determine exactly, on account of the weak lustre of the crystalline facets of fluorine compounds, and of this one in particular.

Fluoride of aluminium, therefore, crystallises in rhombohedra of about 88·30°, and not in cubes, as I hitherto supposed. (For the properties of this substance, see *Annales de Chimie et de Physique*, third series, vol. xlix., p. 79.) If it is wished to prepare cryolite artificially, the best plan is to treat non-ferruginous kaolin with hydrofluosilicic acid, which gives fluoride of aluminium. Upon causing marine salt to react upon the same acid slightly concentrated, and warm gaseous hydrochloric acid and fluosilicate of soda are obtained. In the cold there is obtained a solution of hydrochloric acid, and an almost insoluble precipitate of fluosilicate of soda. When this is calcined in a muffle, it is transformed into fluoride of sodium, which, when mixed and fused with the fluoride of aluminium, gives cryolite.

Cryolite may be also obtained by treating fluoride of sodium with hydrated fluoride of aluminium; it is precipitated in the pulverulent state.

The hydrofluosilicic acid I have prepared in all my experiments by passing steam, or better by allowing water to fall, drop by drop, on a coarse mixture of sand and pounded fluoride of calcium heated to redness in a tubulated stone retort, and condensing the vapours of hydrofluo silicic acid, which will be a sufficiently strong liquid to mark 17° of the hydrometer, and which may be brought by concentration up to 29° or 30°. Not a trace of silica is deposited in this operation. Hydrofluo silicic acid prepared by means of fluoride of silicium and water only marks 4° or 5° when the water has become solid with the gelatinous silica.

At 7° Baumé, hydrofluo silicic acid in solution contains 66 grammes per litre of anhydrous acid ($2SiFl_3.3HFl$).

At 29° it contains 325 grammes per litre, and possesses its maximum concentration.

I have performed these determinations by taking 10 cubic centimètres of the acid under trial, and treating it with an alcoholic solution of acetate of potash, and washing with alcohol the fluosilicate of potash, which appears gummy, but which is readily permeated by liquids. Dry the filter, and weigh the fluosilicate after having heated it. The fluosilicates of soda are crystalline and tolerably dense salts, which only appear gelatinous and transparent because their index of refraction is scarcely superior to that of water itself. Hydrofluo silicic acid at 29° is a very powerful acid, which drives off by the aid of heat almost all other acids, sulphuric excepted. It cannot be preserved in glass, but it neither attacks wood nor organic matters, and it may be preserved in small casks. It changes glass into fluosilicate of soda with great rapidity. I am persuaded that it will become of great industrial importance when its economic manufacture is understood.

3. Iron and Pyrites.—Clay can be used instead of kaolin to prepare pure aluminous products. But it must not be imagined that the iron contained in the clay can be removed from it by treatment with muriatic acid. That which is in a state of oxide is dissolved, but there remains iron in the form of pyrites. To completely purify clays, they must be digested with a solution of hypochlorous or hypochloric acid, which may be very easily prepared by a method given by MM. Calvert and Davies (by heating in a water-bath a mixture of equal parts of oxalic acid and chlorate of potash, and collecting the gas in water). This is the analytical process which I have for some years taught my pupils at the Ecole Normale to dissolve metallic sulphides, and to estimate the pyrites in clays and hydraulic limestone. The pyrite is transformed into sulphate of iron upon contact with the hypochlorous acid, which does not attack the sesquioxide and carbonate of iron.

Clays thus treated become white and at once suitable for the manufacture of pure aluminous products by the methods just described.

4. Vanadium.—Whilst conducting my researches on the mineral from Baux, M. Terreil informed me that M. Beauvallet thought that he had found small quantities of vanadium in clay from the neighbourhood of Paris. I mentioned in the following terms this interesting discovery, hitherto unpublished, in the memoir of my own experiments, presented to the Académie des Sciences of Paris:—"I have heard in connection with researches which are not my own that vanadium is likely to become more common than could be imagined. If the experiments to which I allude are confirmed, they will impart a still greater interest to a body which is at present extremely rare, but with which the labours of Sefstrom, Berzelius, Wöhler, and H. Rose have made us thoroughly acquainted."

And, indeed, M. Beauvallet shortly after published his own researches. This young chemist has shown me some very finely-crystallised vanadiate of ammonia, which he had obtained from the clays of Gentilly. M. Terreil has since confirmed them by extracting small quantities of vanadium from the refractory clays of Forges-les-Eaux. It, therefore, seems to be well established that the presence of vanadium may be discovered in all aluminous, and often in ferruginous, minerals. Captain Caron has found it in the emerald of Naxos, in a certain number of natural aluminates, and lastly, in a very abundant iron ore found in the department of Cher.

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, *Member of the Royal Academy of Belgium.*

(Continued from page 245.)

Determination of the Relation of the Atomic Weights of Silver and Chloride of Potassium, Chloride of Sodium, and Chloride of Ammonium.—The determination of the relations between the atomic weights of these four bodies can be made with such exactness that if we can arrive at the conviction or the certainty that the bodies experimented upon are pure, the result obtained should be considered as almost absolutely exact. I have, therefore, in these determinations, an infallible means of submitting Prout's law to a decisive irrevocable proof. I have, therefore, taken all imaginable care to procure these chlorides pure. To ensure this, I have had recourse to physical and chemical forces to separate the bodies which may be combined or mixed in a more or less stable manner. In order to make the results control each other, I have repeated the determinations so great a number of times that I much doubt whether there exists in the annals of chemical science an example of a greater endeavour to arrive at the discovery of the truth. I have devoted a whole year to these experiments, which are apparently so simple.

Determination of the Relation which exists between the Atomic Weights of Silver and Chloride of Potassium.—I will detail, as briefly as possible, all the means which I have employed to procure the chloride of potassium. This account may appear tedious, but it seems to me quite indispensable; for I attach great importance to the determination of the relation existing between these two bodies.

1. Chloride of Potassium from Chlorate of Potash.—The purest chlorate of potash which can be obtained by means of repeated crystallisation always contains iron, manganese, silica, and sometimes alumina and copper. M. de Marignac has already proved the difficulty of separating iron from both chlorate and perchlorate. To effect the elimination of these impurities, I add to a filtered and boiling solution of chlorate, rendered alkaline by pure potash, a few drops of sulphide of potassium solution. After boiling for a quarter of an hour, I filter the boiling liquid and add to it, still keeping it in ebullition, a fresh quantity of sulphide of potassium. If, after the first addition of the alkaline sulphide, the liquid has been kept long enough in ebul-

lition, the subsequent addition does not occasion the least discoloration. When this is the case, I quickly cool the solution, so as to obtain the salt in the form of a crystalline powder. The magma is introduced into a displacement apparatus, the bottom of which is closed by a linen plug, and washed at first with alkaline and afterwards with acid water. This apparatus is connected, by means of a caoutchouc tube, with a reservoir which is in communication with an air-pump. A few strokes of the pump immediately remove the mother-liquor and the salt appears dry. I then moisten it with pure water, a few drops only at a time, constantly working the pump until the liquid which escapes below has no alkaline[1] reaction, and neither precipitates nor colours nitrate of silver. When the purification is effected in this manner, very little washing water is required. Two kilogrammes of commercial chlorate yielded at one operation from seven to eight hundred grammes of salt, perfectly free from iron, copper, and chlorine, but still retaining silica, and sometimes alumina. I then dissolve it three times in succession in pure water, taking the precaution each time to cool the solution rapidly and eliminate the mother-liquor in the displacement apparatus, with the assistance of the air-pump.

I then decompose the chlorate thus purified and dried in a platinum retort by a careful application of heat. Traces of chlorine are evolved and a chloride is produced which has not the least alkaline reaction. Upon employing chlorate obtained by means of crystallisation only, and which consequently retains at least manganese, iron, and silica, a decided disengagement of chlorine takes place and an alkaline chloride is produced. The purest chloride, when it is decomposed without a judicious management of the heat produces, however, a very notable disengagement of chlorine.

Since the chloride thus procured still contains traces of silica, and sometimes of alumina, it must be purified from them. The following are the various methods to which I have had recourse to obtain this result:—

I fuse the chloride in a platinum crucible enclosed in a second crucible. I then introduce into the liquid a bent platinum wire, to the curve of which I attach a pellet of fine platinum wire. I thus collect together all the suspended matter. When there are no more brilliant points—for it is under this form that silica and alumina present themselves in fused chlorides—I allow the crucibles to cool slowly. When part of the chloride is solidified I decant it, and cause the portion still liquid to pass through the solid mass. I thus effect a veritable filtration of the fused chloride through crystals of the same substance.

The chloride, after it has been received into a platinum dish and become solidified, appears under the form of either a vitreous, colourless, and perfectly homogeneous substance, or as a crystalline mass, of a cubical structure, according as the cooling has been rapid or slow. In these two conditions it possesses a sensibly different specific gravity.

I have only made use of this chloride for my determinations when a portion dissolved in water produces a liquid which is neutral to test-paper and absolutely limpid, which is, I confess, very seldom.

The results given under numbers I. and II. (Second Series) were derived from two different specimens of chloride obtained in this manner.

The chloride thus purified was dissolved in pure water, contained in a platinum dish. After standing for some time, the perfectly clear solution has been decanted into a platinum retort and mixed with chloride of ammonium, obtained by the direct combination of ammonia with hydrochloric acid, both pure and in the gaseous state. The mixture is evaporated to dryness. The residue, well dried, was introduced, by small portions at a time, into a platinum crucible, contained in a second one, and fused. After cooling, the still liquid portion of the chloride was filtered through the crystalline mass.

Chloride of potassium thus prepared has always been perfectly colourless and homogeneous. When dissolved in water it forms a solution absolutely limpid and perfectly neutral to test-paper.

Numbers III., IV., and IX., the weighings of which have been performed *in vacuo*, were effected with two different specimens of this chloride.

Although these chlorides have furnished such concordant results, they may, nevertheless, contain other chlorides. I have, therefore, attempted to satisfy myself on this point by two distinct methods,—firstly, by dividing one portion of these chlorides into four successive parts by crystallisation from a pure aqueous solution; and, secondly, by causing a chemical force to act upon the chloride,—that is to say, by uniting it into a perfectly definite compound susceptible of being well purified.

To this end I have saturated about 200 cubic centimètres of pure boiling water, contained in a platinum dish, with chloride of potassium, from determination No. IX. (Second Series), and I have rapidly effected its crystallisation. The mother-liquor, decanted and mixed with the washing waters, was evaporated until a pellicle was formed on its surface; this furnished a second mother-liquor, which was evaporated after the addition of the washing waters until a pellicle formed and yielded a third crop of chloride. The mother-liquor from this was evaporated to dryness. The four specimens of chloride which were obtained in decreasing quantities were mixed with a tenth part of their weight of pure chloride of ammonium and thus submitted to fusion.

All these chlorides were colourless and dissolved in water, producing a neutral and perfectly clear liquid. The results given under the numbers IX. *a*, IX. *b*, IX *c*, IX. *d*, are obtained from determinations made with these four specimens of chloride.

2. Chloride of Potassium from Chloroplatinate of Potassium.—I have united chloride of potassium from the chlorate with bichloride of platinum, in order to separate the chlorides which it might contain, and which crystallisation would not remove. For this object I procured a sufficient quantity of pure platinum. To get this I followed the method described by Berzelius, which is, however, very expensive, inasmuch as it necessitates the complete destruction of a large platinum crucible in which the operation is performed. I have repeated the purification three times instead of twice, as recommended by the illustrious Swedish chemist. Platinum thus purified is much whiter than the metal met with in commerce, and when fused is excessively ductile and malleable, as M. H. St. Claire Deville has recently stated.

I then dissolved this platinum in weak aqua regia, employing for this purpose a Bohemian glass flask. The chloride, evaporated to dryness, was dissolved in alcohol. I then added an aqueous solution of chloride of potassium from the chlorate, taking care to leave the platinum in excess. The chloroplatinate of potassium was washed first with dilute alcohol, containing chloride of platinum in solution, and then with weak pure alcohol. The

[1] Acid?

chloroplatinate of potassium was mixed with a fourth of its weight of perfectly pure chloride of ammonium and calcined at a bright red heat in a platinum crucible. The residue was dissolved in cold, pure water, and the solution was filtered through pure, spongy platinum, which had been strongly heated and placed in a drawn-out funnel. I took the platinum sponge as a means of filtration because I found that a solution of alkaline chlorides passed through paper always took from it traces of silica.

In order to get rid of the small metallic particles which might have been carried through, I allowed the solution to remain undisturbed for at least twenty-four hours in a platinum dish. At the end of this time the liquid was carefully decanted, mixed with pure sal-ammoniac, and evaporated to dryness in a platinum dish; it was finally fused in a double platinum crucible. The fused chloride never presented any traces of brilliant spangles. It may be decanted to the last drop without any foreign body whatever being perceived. When solid it is perfectly colourless, and when dissolved in water produces an absolutely pure and neutral solution.

Numbers v. and vi. (Second Series) of the Table refer to chloride of potassium purified from chloroplatinate of potash; and Number vii. to the same chloride, which was twice combined and twice separated by the means just indicated.

3. Chloride of Potassium from Nitre.—Two different specimens of nitre, weighing about 250 grammes each, which had been crystallised at least ten times each, and were completely freed from iron, manganese, copper, &c., were mixed with one and a-half times their weight of pure chloride of ammonium. Each of these mixtures was projected, little by little, into a large platinum capsule heated to full redness. The first portion of the mixture attacked the platinum pretty strongly, but when once the bottom was covered with alkaline chloride the additions of the liquid could be continued without sensibly altering the metal. At each addition a deflagration was produced. The resulting chloride of potassium was pulverised and mixed with a tenth of its weight of pure sal-ammoniac and of chloroplatinate of ammonia. The whole was fused in a double crucible of platinum. The platinum derived from the decomposition of the chloroplatinate of ammonium carries down with it to the bottom of the crucible the silica which the purest nitre always contains. After standing a certain time, the liquid is decanted into a platinum vessel. The chloride or potassium thus obtained has a very decided violet tint, due to the presence of very finely-divided platinum.

To separate this platinum, I dissolve the chloride in cold, pure water, and filter the solution through strongly-ignited platinum sponge. The filtered liquid, after standing for twenty-four hours, was treated in the way described for chloride of potassium extracted from the chloroplatinate of potassium.

The two specimens of chloride thus produced were each perfectly colourless, neutral to test-paper, and yielded with cold water an absolutely limpid liquid.

The determinations of Numbers viii. and x. (Second Series) refer to these two specimens.

At least fifty grammes of the chloride of Number x. were dissolved in pure water and divided by crystallisation into four successively diminishing portions, as explained in the case of the chloride prepared from the chlorate. I have determined the proportional relation of the four specimens thus obtained; the result is given in Numbers x. *a*, x. *b*, x. *c*, x d (Second Series).

4. Chloride of Potassium prepared from Tartar.—Cream of tartar, crystallised ten times, was carbonised in a silver crucible and the carbon exhausted with pure water. The carbonate of potash was mixed with an excess of pure hydrochloric acid and the liquid evaporated to dryness. The residue was heated to dull redness and taken up after cooling with cold water. The solution was allowed to rest until it had become perfectly limpid by the deposition of silica; then decanted and supersaturated with ammonia it allowed traces of peroxide of iron and alumina to be deposited. After the liquid had again become clear I evaporated it in a platinum vessel and mixed the residue with a tenth part of its weight of pure sal-ammoniac and of chloroplatinate of ammonium. The mixture was fused, and the resulting chloride, as I have explained in the case of the chloride of potassium, prepared from nitre.

This chloride was absolutely colourless, neutral, and dissolved in water, forming a perfectly limpid liquid.

The results given under Number xi. refer to the chloride prepared in this manner.

(To be continued.)

Notes on Nitrification, by R. Haines, *M.B., Professor of Materia Medica, Grant Medical College, Bombay.*

(*Continued from page* 246.)

A further step has been taken by M. de Luca, who has shown that porous substances were not essential to this combination. Air was ozonised by passing over phosphorus, then purified by passing through carded cotton, and over potassa and sulphuric acid; the pure ozonised air then passed over potassium and pure potassa. In three months the potassium became converted to potassa and deliquesced, and from both alkaline solutions nitrate of potassa could then be separated by crystallisation.[1]

Oxygen, then, in the form of ozone, required but the concomitant predisposing affinity of an alkali to unite at once with nitrogen as nitric acid. Ozone, as Schönbein has shown us, is produced whenever an electric spark traverses atmospheric air; hence, in Cavendish's experiments it is ozone which is the medium of the combination, the water of the air and the gas jar playing the part of base, and not a feeble one, to the newly-formed acid.

But ozone, besides being produced artificially during the slow combustion of phosphorus and by electric sparks, is a natural and normal constituent of atmospheric air: it is believed to be chiefly formed during the evolution of oxygen by the leaves of plants. It is comparatively abundant in the air of rural districts, but disappears almost completely in the air of large towns or in crowded dwelling-houses. It remained, then, with regard to the nitrifying powers of oxygen and uncombined nitrogen, merely to put to the crucial test of more natural conditions the phenomena thus artificially evoked.

This also has been effected by M. de Luca. He prepared three sets of apparatus similar to those last described, but without the ozonising portion by which atmospheric air was slowly drawn first through carded cotton, then over sulphuric acid, then over potassium, and, lastly, over hydrate of potassa. Two such apparatus were set to work in the court of the laboratory of the College of France, and one in a hot-house of the Botanic Gardens at the Luxembourg. The apparatus worked only during the day for six months; at the end of that

[1] *Comptes-Rendus*, December 31, 1855.

time both the potassium and the hydrate of potassa had run down into liquid potassa in all. In this liquid, in the two apparatus in the open air at the College of France, not a trace of nitric acid could be found; in that in the hot-house there was abundance of nitric acid, so that nitrate of potassa had begun to crystallise out.

There are, therefore, two distinct methods in which nitric acid is formed in nature, which are alike only in this, that both are processes of oxidation, and that in both the presence of some powerful basic material is essential to determine the combination. In the one, ordinary oxygen and ammonia are, by the agency of porous bodies, condensed in their pores, and in the presence of alkaline bases made to combine and form nitrates of such bases; in the other ozonised oxygen, whose affinities are vastly more powerful, unites directly with nitrogen in the presence of strong bases. Both these processes, there is every probability, go on incessantly; the nitric acid of the air being chiefly formed by the latter method; that of the soil chiefly, but not exclusively, by the former; not exclusively, because if ozone can oxidise nitrogen without the intervention of porous bodies, still more readily will it do so when it meets with them along with ordinary oxygen.

The question, in reference to the researches of De Luca, is of interest in another way, as it concerns the balance of organic nature. Hitherto it seems to have been the received doctrine that the quantity of combined nitrogen in the globe was constant, not susceptible at least, of increase. Philosophers have, I know, been chary of broadly stating this in so many words, but it is tacitly assumed whenever the subject is touched upon in the works of Liebig, Dumas, and others of the organo-chemical school which they have established. It is concluded, without dispute, that the nitrogenous proximate principles of animal bodies are directly derived from the nitrogenous principles of the vegetables which form their food. Animals appear to be totally destitute of the power of assimilating nitrogen, as such; neither can they convert such simple compounds as ammonia or nitric acid into the complex principles of animal life. On the contrary, if the careful and concordant experiments of Regnault and Reiset, of Valentin and Brünner, and of Boussingault, are correct, a portion at least of such nitrogenous principles suffers entire destruction, and the nitrogen is evolved uncombined, for expired air always contains an excess of nitrogen, which can only be derived from the decomposition of nitrogenous compounds.

During the natural decay of animal structures the whole of the nitrogen is evolved in the form of ammonia, or of some of its modifications, and by this ammonia vegetables are nourished, and by further combinations the plastic materials which are to form the food of animals are built up. In this circulation of the nutrient materials of the animal and vegetable worlds, ammonia forms the zero point to which once in every round the nitrogen compounds unceasingly return,—not, however, as we have seen, without diminution.

Again, vegetables have as little power as animals to assimilate uncombined nitrogen, but their capacity to destroy such already-formed combinations far exceeds that of animals; the oxygen exhaled by the leaves is invariably mixed with pure nitrogen, which in some cases equals, or even exceeds, the oxygen in volume. This nitrogen can only be produced from the decomposition of the absorbed ammonia, or its equivalent nitric acid.

Moreover, the nitric acid which is formed so abundantly from ammonia is liable to total decomposition. Whenever gunpowder or similar mixtures are burnt, the nitrogen of the nitrate is evolved in a free state, no longer capable of taking its place in the series of transformations. The cycle is to some extent a double one,—nitric acid forming the starting point of a loop line,—in every stage of which except one the combined nitrogen suffers diminution, thus:—

1. Ammonia { 2. Ammonia 3. Vegetable* Principles
2. Nitric acid* 3. Vegetable* Principles
4. Animal* Principles } 5. Ammonia.
4. Ammonia }

The points of the series at which this diminution occurs are marked by an asterisk.

Of the original formation of ammonia we know little. The numerous experiments by which it has been attempted to show its production by the union of free nitrogen with nascent hydrogen, are all inconclusive. That it exists, however, in the interior of the earth, is shown by the fact of its almost constant occurrence in the vapours emitted from volcanoes, in the Soffioni of Tuscany (with boracic acid), and in solid masses of rock-salt. In Liebig's words, it "has not been produced by the animal organism: it existed before the creation of human beings; it is a part, a primary constituent, of the globe itself."[2] But the amount given off in the atmosphere cannot be very great; hardly comparable, one would think, with the amount destroyed in the functions of animal and vegetable life. It is not, therefore, without some reason that the fears expressed in the following extract should have occurred to a thoughtful observer:—

"With regard to gunpowder, the question may well be raised, whether its use can be said to harmonise with the economy of Nature. I do not mean by this the consideration that men and animals are killed by means of firearms, but rather the fact that by the combustion of gunpowder a portion of nitrogen which formerly belonged to Nature's capital stock of ammonia, is turned off into the atmosphere as free nitrogen, no longer capable of taking a part in the molecular transformations of the vital organism. The result, therefore, cannot but be, that the capital stock of ammonia in Nature will, in course of time, be diminished; for we are unacquainted with any natural phenomenon whatever capable of augmenting it. If this be the case, the vegetable and animal kingdoms must, after some thousands of years, suffer diminution."[3]

Our knowledge of the natural formation of nitric acid through the medium of ozonised oxygen, if worthy of interest on no other grounds, will at least satisfy our conceptions as to the universal harmony of natural operations, and will tend to relieve our fears for the well-being of a distant, and, we may now hope, flourishing posterity.

TECHNICAL CHEMISTRY.

The City Pumps,[4] *by* H. Letheby, *M.B., M.A., Ph.D., &c., Medical Officer of Health for the City of London.*

The water from twelve of the City pumps has been analysed during the quarter, and the results, as in former

[2] "Agricultural Chemistry," First Edition, p. 109.

[3] Mohr's "Commentar zur Preussischen Pharmacopöe," ii. 34.

[4] From the "Quarterly Report on the Sanitary Condition of the City of London."

cases, show an enormous amount of saline and organic impurity. Up to the present time there have been thirty-four of the City pumps examined, and in every case the water has been fouled with surface drainage. Not one of them derives its supply from the deep strata of the London basin; and, excepting the pump in Glovers' Hall Court, and that in Guildhall Buildings, none of them furnish water that is fit for domestic purposes; indeed, it is difficult to understand what motive or inclination can lead persons to the continued use of them. If such water were supplied by the public companies of London, there would be an universal condemnation of it; for at the best of times, some of these pumps yield water which contains from 100 to 130 grains of saline and organic matter in the gallon; and all of them are excessively hard from the altered products of decomposition. The fact of the presence of ammonia, saltpetre, sulphate of lime, common salt, and organic matter in large proportions is sufficient to indicate the source of the supply; and the knowledge of the composition of the soil through which the water passes should warn us of the danger that may at any moment arise from its use. It may be that the water has often been drunk with apparent impunity, and that it has rarely shown any immediate manifestation of its morbific action; but it cannot be that the products of corruption can be constantly admitted into the human body without danger of insidious mischief,—and there is the still greater danger of the impurities of the soil passing unchanged into the water, and being a source of quick and certain injury. This is indicated by the circumstance that the water from the City wells is constantly changing,—that it is hardly the same from hour to hour; for the soil through which it passes is pierced in every direction with drains and sewers, and is charged with every species of corrupting refuse, which passes in variable proportions into the porous strata from which the water is pumped. This ought to tell us, not merely of the disgusting nature of the supply, but also of the dangers which accompany it. Experience has shown that wells like these are liable at any moment to receive the leakings from a cesspool or a sewer, and thus to be the immediate cause of fatal disease. In the autumn of 1854 there was a sudden and serious outbreak of cholera in the parish of St. James, Westminster. The course of the disease was confined to a small area in the neighbourhood of a favourite pump in Broad Street; and soon it was remarked, that of seventy-three persons who died during the first days of the visitation, sixty-one had been drinking the water of the pump. It was also remarked, that among persons who were living in the same street, and occasionally in the same houses, those only were attacked who drank the favourite water of the pump; in fact, in a number of cases which were particularly investigated, it was ascertained that persons who lived at a distance from the parish, and who had the water sent to them because of its supposed goodness, were seized with cholera and died. A full inquiry into all the circumstances of the matter proved that the well had become charged with cesspool drainage, and had thus acquired its poisonous action. The pollution had perhaps been going on for years, and yet the water had not betrayed it, and had been drunk with comparative impunity: indeed, its cool and sparkling qualities, the fatal fascinations of corruption, had gained for it such a high repute in the neighbourhood, that it was a favourite water, and was generally drank. Another such a case occurred at West Ham, in Surrey, in the autumn of 1857. Suddenly at that place there was a visitation of cholera in a row of sixteen cottages that were apparently isolated from epidemic influences. It showed itself along one side of the street, where, in a few days, thirteen persons were attacked with the disease, seven of whom died. Dr. Elliott, the Health Officer for the district, suspected from his inquiries that the common pump on that side of the street had been concerned in the mischief; its water was, therefore, examined, and it was found to be polluted with the soakage from an adjoining sewer. At once the use of it was interdicted, and, to make the matter certain, the handle of the pump was taken away, and from that moment the further spread of the disease was arrested.

Again: in the cholera visitations of 1848-9 and 1853-4, there were two striking examples of the influence of such water in the propagation of disease. The southern districts of London, comprising nearly a fifth of the population of the metropolis, were visited most severely with cholera at both of those outbreaks, and the persons who suffered most on each occasion, were those who drank the worst quality of water. The inhabitants of those districts are supplied by two rival companies, who obtained their water from the Thames at different parts of its course. In one case the water was charged with a larger amount of organic matter than in the other; and, although the conditions of the population were in every other respect the same, yet this had the effect of augmenting the mortality to a frightful extent. In the second visitation of the disease, the circumstances of the supply were changed: the water of the old company, which was once the worst, was then the best, and the severity of the disease was changed likewise; for those who partook of the still bad supply suffered as before, and their mortality was three and a-half times greater than their neighbours. Here was an experiment on a large scale, such as "no sceptical philosopher would have dared to propose," in which a large number of persons were placed under circumstances exactly alike, except in one particular, namely, in the use of a water charged to a comparatively small extent with organic pollution, and this determined the result—a mortality of 130 in the 10,000 instead of 37. A similar tale may be told of the cholera visitation of other places in this country. The town of Newcastle-upon-Tyne was supplied with comparatively pure water in the year 1849, and it then suffered but little from cholera; whereas, in the visitation of 1853, when there was so calamitous a loss of life from this disease, the water supply was made impure by the drainage from the sewers. "The same effect," says Dr. Farr, "was the result of the same cause in Hull, in 1849. And other examples may be cited, in which the converse happened, as at Exeter, where the inhabitants, after having suffered severely from cholera in 1852, obtained pure water, and escaped its ravages."

Nor are the percolations from the graveyards of a city less injurious; experience has demonstrated that this also is a prolific source of disease. Sir James Macgregor relates, that when the British army was in Spain, about 20,000 soldiers were buried in a rather small space of ground; this was going on for two or three months, and soon the troops who drank the water from the wells of the neighbourhood, were attacked with dysentery and malignant fevers. The cause of the mischief was clearly traced to the hardly recognisable impurity in the water from the shallow wells. Here, however, in the churchyards of this City, there are the remains of ten times such a buried army undergoing decay; and in the whole of this metropolis, in a space of not more than 218 acres of soil, there were buried not long since as many as

50,000 dead in the year. In a generation of thirty years, this would give us a million and a-half of decomposing bodies in the surface soil of London; and through these the water percolates, to find its way into the porous stratum which supplies the shallow wells. At best, the change of this corruption is but imperfect, and the presence of ammonia and saltpetre tells of the process of decay, and indicates the danger which accompanies it.

All these considerations have forced upon us the conclusion that water from rivers and surface wells, contaminated with the refuse of drains, and the soakings from graveyards, is unfit for public use; and, with the knowledge of this fact, I should be wanting in my duty, as your sanitary officer, if I failed to inform you of it.

On Aniline Blue, by M. Ch. Lauth.[1]

A comparison of the formula of aniline violet, $C_{36}\,H_{17}\,N_3\,O_2$, with that of aniline red, $C_{36}\,H_{20}\,N_4\,O_4$, led me to think that by treating the latter with reducing agents, it might be transformed into the violet. I therefore tried all the ordinary reducing agents, but none produced a satisfactory result. When treating, however, a solution of aniline red in commercial alcohol with a salt of tin, I noticed that the colour of the mixture, which at first was yellow, slowly became brownish, then green, and finally blue. The red matter had disappeared, and a new product had formed—aniline blue. I soon convinced myself that the active agent in this transformation was aldehyde, commercial alcohol always containing a certain quantity of this body. I now prepared some chemically pure aldehyde by means of the aldehydate of ammonia. I also prepared pure mononitrated trianiline by the following process:—Rough aniline red was mixed with four times its weight of sand, and then treated several times with boiling water. The sand was used to retain the resinous matters which always accompany rough aniline. The aqueous solutions were now precipitated by means of common salt, and the precipitated colour was again treated as the rough product had been. This operation was repeated three times; the last solutions in boiling water were treated with a boiling solution of common salt, and on cooling the liquid deposited brilliant crystals of mononitrated trianiline.

These crystals are dissolved in sulphuric acid diluted with four times its volume of water, and to that solution the pure aldehyde is added. The reaction commences in a few minutes, and after a time, longer or shorter, according to the quantity of aldehyde and acid employed, the red colour completely disappears, and gives place to a beautiful blue. As soon as the change takes place, the liquid must be saturated with caustic soda, which causes an abundant precipitate of the new colouring matter. The liquor contains acetate of ammonia.

In the above reaction aldehyde may be replaced by most of the hydrides, the essential oil of bitter almonds, the hydride of valeryl, and the oils of rue and aniseed. Any acid or acid salt may also be substituted for sulphuric acid. It is most probable that the transformation of the red to a blue colour, is due to some reducing action. M. Willm, however, is occupied with the analysis of the products, and will shortly publish his results.

The new colour has the following properties:—It is soluble in alcohol, ether, glycerine, &c., and dissolves in acids and alkalies. It is precipitated from the latter solutions when they are saturated. It is completely precipitated from its solutions by tannin, which forms with it a compound totally insoluble in water, only slightly soluble in alcohol, but more so in acetic acid.

The blue compound possesses most of the chemical properties of the other coloured derivatives of aniline, but not their stability. At 200° it is completely destroyed. Light quickly acts on it. It dyes wool, silk, and albumenized cotton, and gives shades of colour of great purity. When combined with aniline red, it produces a violet incomparably more beautiful than the ordinary violet.

[1] *Bulletin de la Société Chimique de Paris*, No. iv. p. 78.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 29, 1861.

J. P. Joule, *LL.D., President, in the Chair.*

Professor A. D. Bache, Superintendent of the United States Coast Survey, and Commander M. F. Maury, of the United States Navy, were elected Corresponding Members of the Society.

John Edward Morgan, Esq., M.B., was elected an Ordinary Member.

Mr. Spence brought before the meeting part of a mass of iron and copper pyrites containing abundance of large and well-defined crystals of pure arsenious acid.

Not only are these crystals a novelty as a natural product, but as an instance of rapid mineralisation they are interesting. The lump was found among a cargo of small disintegrated ore imported from Huelva, in Spain, and containing no solid masses of large size, and the lump was merely an aggregation of small pieces firmly agglutinated together and full of hollow cavities, studded over with the crystals of arsenious acid; and from the history of the cargo of ore it is not probable that more than twelve months has been required for their development. Heat does not seem to have been the cause of the metamorphosis, as there is no evidence of heat at all approaching to ignition having occurred; discoloration of the ore would at once have been the result of this.

The ore is chiefly a sulphide of iron and copper; but as an arsenide of one or both of these metals exist in it, decomposition of this latter must have taken place; the arsenic has become oxidised, and crystals of arsenious acid are the result.

The piece of ore will be deposited in the Society's mineral collection.

The discovery of these crystals being pure arsenious acid was made by Mr. Bottomley, Mr. Spence's assistant in his laboratory.

An interesting conversation followed, in which the fact was stated that arsenic is a constituent of nearly all the artificial manures which have superphosphate of lime as their basis; and in connection with this a report was named of arsenic having been found in some of the crops grown with such manures.

Professor Roscoe exhibited the beautiful lithographic map representing the dark lines in a portion of the solar spectrum, lately published by Professor Kirchhoff. The lines are printed in ink of six different shades, and are of six different degrees of thickness, so that the leading features of the spectrum can be at once recognised. The position of the bright lines produced by the incandescent vapour of certain metals is also given on the map, and the coincidence of many of these with the dark Frauenhofer's lines rendered evident.

Professor Roscoe stated that the length of the drawings when complete would amount to some twenty feet, and that to give an idea of the scale on which the map was

made, he might remark that the distance between the two double lines "D" is upwards of four millimètres. These maps are as yet only printed together with the memoir by Professor Kirchhoff, upon the Solar Spectrum and the Spectra of the Chemical Elements in the Transactions of the Berlin Academy; an English edition will, however, shortly be published, giving a translation of the original memoir, and containing the same drawings of the spectrum as those exhibited, which accompany the German text.

Dr. R. Angus Smith read the first part of "An Examination into the Products of the Putrefaction of Blood." He found that 54° Fahr., or nearly so, was a marked temperature; that below it there was little putrefaction, but above it a large amount, which increased as the temperature increased as far as he tried, viz., to 72° F. The amount of gas given in twenty-four hours, from three quarts of diluted blood, was one hundred cubic centimètres, at 57° F. (16° Cels.), but on raising the temperature to 72° (22° Cels.) the amount of gas in the same period rose to 397 C.C., or four times the amount of putrefaction by fifteen degrees rise of temperature. When the temperature was below 54°, no gas could be collected for many days. A very short rise above 54° caused sufficient pressure to allow gas to be collected. These facts were used to illustrate climate and sudden spread of disease.

During the early period of putrefaction, the Author found the sulphuretted hydrogen and organic matter to increase rapidly. One hundred cubic centimètres destroyed 29 of a solution of permanganate; the amount then rose rapidly to 36, 40·6, 41, 60·2.

Nearly ninety-eight per cent. of the gas that escaped was found to be carbonic acid and gases with a similar action, *i.e.*, absorbed readily by caustic alkalies.

The gases were found to be:—

Carbonic Acid.	Sulphuretted Hydrogen.	Residue.
82·68	—	17·32
85·78	—	14·22
89·72	—	10·28
95·40	—	4·60
96·20	—	3·80
96·07	1·58	2·35
96·43	2·78	0·79
97·62	0·06	2·31
97·09	1·93	1·98

The residual gas was found to consist of:—

Carbonic Oxide	4·8	per cent.
Carburetted Hydrogen	2·5	,,
Hydrogen	6·2	,,
Nitrogen	86·5	,,
	100·	

Where the sulphuretted hydrogen is 1·5, the sulphur is to the carbon as 1 to 24·8

Both the oxygen and carbon of the carbonic acid are derived from the blood, which is therefore carried rapidly away.

The point of greatest importance was said, by the author, to be the separation of these substances, which do not seem to be pure gases, and which are entirely absorbed by alkalies, and partly by acids and metallic salts. The portion absorbed by acids salts was found to contain carbon and nitrogen, in the relation of 140 to 54, or as 100 to 38·5; but part of this was evidently as ammonia. In albumen it exists in the relation of 100 to 28·9. The whole of the putrefactive matters were not removed by acids or by acid salts. When the carbonic acid and sulphuretted hydrogen are removed, the putrefactive matters still remain. These gases, therefore, are not the only substances to be feared.

The condition in which these putrefactive bodies exist was then discussed. The author believed that one of the conditions in which solid substances were taken into the air was in solution, the solution itself being taken up as a vesicle; and he instanced analogous cases, such as sulphuric acid and zinc when hydrogen is forming. The liquid evaporates and a concrete globule forms, leaving at last a portion of solid matter in various states. This condition can be supposed to occur readily in many cases, but it does not appear to be the probable result in all cases, as he cannot readily imagine vesicles coming through the close pores of bodies such as are penetrated by these vapours. Between the actually mechanical method of taking solid matter into the air, such as when waves are agitated by the wind, and the purely chemical method, such as when a liquid is transformed into a vapour by heat, there must be many intermediate stages. These stages are required, apparently, as we can scarcely imagine pure gases undergoing transformation similar to bodies in a putrefactive state; and we are not prepared with a theory by which diseases will be communicated without the agency of bodies in such a state of change—one of the oldest of theories and one promising to live long. Besides, the fact of a substance being found capable of being absorbed by metallic salts, and containing carbon with nitrogen in such a large amount, leads us to believe that bodies not very far removed from the substances decomposed are found in the vapours, and, if not far removed, capable of undergoing transformations so as to become farther removed, and by such transformations exercising their special influence.

MICROSCOPICAL SECTION.

October 21, 1861.

Professor Williamson *in the Chair.*

The following gentlemen were elected members of the Section:—Mr. Murray Gladstone, Mr. John Whalley, Mr. William Henry Heys, Dr. William Roberts, and Dr. Thomas Alcock.

The Secretary presented sixty specimens of soundings received since the last Session, from the commanders of various steamers and sailing vessels, amongst which were a number from the south coast of Ireland, banks of Newfoundland, coast of Nantucket, United States, north coast of Brazil, &c. The Secretary was requested to write a letter of thanks from the Section to each contributor.

The Chairman remarked that these specimens deserved the best attention of the Section, not only on account of their intrinsic interest, but to show the contributors that their kindness in preserving the soundings for the Section was fully appreciated.

Mr. Dale offered, with the assistance of the Secretary, to prepare the material, by separation from the tallow, &c., and Mr. Nevill, Mr. Heys, and several other gentlemen offered their assistance in mounting, examination, and reporting to the Section.

The Chairman observed that the method he employed in the preliminary examination of similar specimens, when freed from tallow and dried, was to stir the mass in a vessel of water, when most of the organic forms rose to the surface, in consequence of containing small quantities of air; the creamings off the top of the liquid would be found to contain sufficient indications whether the specimens deserved further attention.

The Secretary read a letter from Mr. Joseph Sidebotham, accompanying a specimen and a drawing of the Aulacodiscus formosus, showing the four projecting knobs or handles visible upon that diatom. Mr. Sidebotham states that in all drawings hitherto published, these protuberances appear like simple elevations or bosses, nor could they be seen otherwise until the binocular microscope revealed their true shape. Mr. Dancer first called his attention to this peculiarity.

Mr. Crompton exhibited, and presented to the members, specimens or capillary tubes used by him to collect and preserve fluids for microscopical examinations for medical purposes. Mr. Crompton has used such tubes for more

than a year, and has preserved specimens of blood, urine, &c., which by any other method would have spoiled. The main feature consists in hermetically sealing the tubes after the introduction of the fluid, by holding their ends alternately in the flame of a candle or lamp until the glass melts, and the orifice closes; the tubes may be about three-fourths filled by capillary attraction or immersion, and care must be taken not to allow the fluid to approach the hot end of the tube whilst being sealed. The Edinburgh vaccine tubes answer the purpose well; they may be about three inches long, and a number of them may be carried in a small pocket case at all times ready to be filled. When required for examination, the tube is broken, and the enclosed fluid placed under the microscope.

The Secretary exhibited a specimen of the compound salt of magnesia and copper, prepared by Mr. Thomas Davies, of Warrington. Doubts have been expressed if it were a true compound salt, or a mere mechanical mixture, Mr. Dale, who at the Secretary's request had prepared some of the salt, undertook to report further upon it. Some forms of crystal were exhibited, producing novel effects by polarised light.

Mr. Lynde exhibited a fine specimen of copper ore, with jasper, from Cornwall, the colour of which, when illuminated with the Lieberkühn, was very gorgeous.

Mr. Latham exhibited the ovary of a flea, and portions of the skin and teeth of the dogfish.

Mr. Heys exhibited specimens, mounted specially for the Lieberkühn, of various seeds, hairs, and glands of plants; the tesselated spines on the Symphytum asperrimum, or rough comfrey, and the ruby coloured oil glands of the origamme onites, glowing, like precious stones, with the reflected light from the above object, was very much admired. For certain classes of objects no illumination can compare with that of the Lieberkühn in the use of the binocular microscope, and side lights may be obtained, to some extent all around the object, by manipulation with the mirror.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, November 4, 1861.
William Pole, Esq., M.A., F.R.S., Treasurer and Vice-President, in the Chair.

The Rev. W. Wentworth H. A. Bowyer, M.A., was elected a Member of the Royal Institution. Alexander J. Ellis, Esq., was admitted a Member of the Royal Institution.

CHEMICAL SOCIETY.

Thursday, November 7, 1861.
Dr. A. W. Hofmann, F.R.S., President, in the Chair.

Mr. Harcourt, of Oxford, read a paper *On the Action of Certain Gases on the Peroxides of Potassium and Sodium*, the method of preparing these bodies having already been published in the Chemical News. His original experiment was to act on potassium and sodium with air and oxygen gas, the metals having been previously filtered through linen, and cast in a glass tube. Under these circumstances sodium combined with two equivalents of oxygen and potassium with as many as four equivalents. The action of water on these oxides had been investigated. Some difficulties arose in conducting the experiments, on account of the powerful action of the oxides on the material of which the containing vessels were composed; glass, platinum, and silver being rapidly attacked at a high temperature, a compound of oxide of silver with oxide of the alkaline metal being produced when a silver vessel was employed; in the case of tetroxide of potassium oxygen was evolved at the same time. These results were obtained by heating the peroxides in a silver boat, and passing over them a current of nitrogen gas, the boat being placed in a glass tube. The action of vapour of sulphur on the peroxides of these two metals was next investigated, when a rather unexpected result was obtained; instead of a sulphate being formed, as might have been anticipated, a sulphide was produced, together with sulphurous acid gas. By the action of iodine on the binoxide of sodium a substance containing sodium, oxygen, and iodine was produced, which was probably a mixture of iodide and iodate of the metal. Carbonic oxide passed over the binoxide of sodium gave rise to the formation of carbonate of soda; with tetroxide of potassium oxygen was evolved and carbonate formed. Carbonic acid also produced carbonate of the metal, oxygen being set free both from the peroxide of sodium and of potassium. With protoxide of nitrogen and binoxide of sodium a nitrite was formed, nitrogen being evolved; this gas, however, seemed to have no action on the tetroxide of potassium. The action of binoxide of nitrogen gave rise to the formation of nitrite of soda; but with the tetroxide of potassium red fumes were produced at the same time from the combination of the oxygen set free from the peroxide with the excess of binoxide of nitrogen; the apparatus was filled with nitrogen before commencing the experiment. The product in this case was a mixture of nitrite and nitrate of potash.

The President inquired whether the substances were heated in the last experiments?

Mr. Harcourt replied that, although heat was employed in most cases, the experiments with the oxides of nitrogen were performed at the ordinary temperature.

The President then remarked on the difference between the deportment of the two metals, potassium and sodium, and asked whether there was any appearance of a binoxide of potassium being formed previously to the higher oxide?

Mr. Harcourt concluded, from the colour of the compound at an intermediate stage, that a lower oxide was first formed: he endeavoured to verify this by determining the increase of weight, but could not obtain a constant result: he also thought there was a possibility of a tetroxide of sodium existing, but the temperature necessary for its production being higher than that required for the preparation of the potassium compound, the containing vessel was destroyed before this point of oxidation could be reached.

A Paper, by Mr. F. A. Abel and Mr. F. Field, *On some of the Results of the Analysis of Commercial Copper*, was then read by Mr. Abel. After referring to the importance of determining accurately the amounts of arsenic, antimony, bismuth, and lead present in different varieties of copper, he stated that the usual method recommended in books on analysis for the separation of arsenic and antimony from copper, namely, by digesting the mixed sulphides of the metals in sulphide of ammonium, was imperfect, for that as much as one per cent. of arsenic, and even twenty or thirty per cent. of tin, might be overlooked, on account of the power possessed by sulphide of copper of holding back the sulphides of these metals, and preventing them entering into solution, as had been pointed out by Mr. Bloxam; and that a better mode of proceeding was to add ammonia to the nitric acid solution of the copper, and then pass sulphuretted hydrogen into the liquid, for that in this case the sulphide of copper was precipitated, whilst the sulphides of arsenic and antimony were retained in solution by the sulphide of ammonium formed at the same time. The following process was recommended for the analysis of commercial copper:—Two hundred grains of the copper were to be dissolved in nitric acid and filtered from slag, &c., a small quantity of a solution of nitrate of lead, and excess of ammonia, and a little carbonate of ammonia

were then to be added, the liquid filtered, and the precipitate washed and digested in oxalic acid solution, filtered from oxalate of lead and of bismuth; a stream of sulphuretted hydrogen passed through the filtrate after the addition of excess of ammonia, and after filtration from a little sulphide of lead, a slight excess of hydrochloric acid added, and the whole to be warmed for a few hours. The presence or absence of antimony could be ascertained with certainty from the colour of the precipitate obtained. For the detection of bismuth and lead, another portion of two hundred grains was to be dissolved in nitric acid, and a little phosphate of soda and excess of ammonia to be added, and the precipitated phosphates of bismuth and lead collected, washed, and dissolved in dilute nitric acid, tartaric acid and excess of ammonia added, and sulphuretted hydrogen passed through the liquid, the precipitated sulphides collected and dissolved in nitric acid, and the solution digested with hydrated oxide of copper, when oxide of bismuth would be precipitated, the oxide of lead remaining in solution; the liquid having been filtered, chromate of potash was to be added to the filtrate when chromate of lead would be precipitated. Iron if present would be found with the bismuth, and could easily be separated. The accuracy of these processes was tested in the following manner:—A hundred grains of electrotype copper were dissolved and treated as directed, and no yellow precipitate was obtained from the ultimate solution on addition of hydrochloric acid. To another portion of a hundred grains one-tenth of a grain of arsenic was added, and this could be easily detected, and even one-hundredth of a grain of arsenic in a hundred grains of copper could be discovered by the process. Antimony in equally small quantities could be separated in the same manner. The process was also applicable for the examination of commercial hydrochloric acid for arsenic. The presence of very minute quantities of arsenic could also be discovered in copper by the magnesia test; the copper to be dissolved in nitric acid, excess of ammonia added and then sulphate of magnesia, and the whole allowed to stand. By this process two hundredths of a grain of arsenic in a hundred grains of copper were detected. The method recommended by Mr. Field, namely, to separate the main bulk of the copper from the solution of the sample in nitric acid by adding oxalic acid; and to examine the filtrate for the other metals, was also efficacious, although the plan before given was preferable. Mr. Abel then alluded to the method recommended by Dr. Odling for examining copper for small quantities of arsenic, which was to act on the finely-divided copper, with cold hydrochloric acid exposing the solution to the air, and after the solution of the copper, to distil the liquid, when chloride of arsenic would be found in the distillate if arsenic were present in the copper. Mr. Abel pointed out that if heat were applied before all the copper was dissolved, arsenietted hydrogen was evolved, but that mere traces of arsenic could be detected in copper by placing a piece of the metal in hydrochloric acid and adding a small quantity of sesquichloride of iron or chlorate of potash, and leaving it to stand for some time, when a grey coating would be formed on the surface of the copper if it contained arsenic; also that a very small quantity of bismuth might be detected by adding to the solution of bismuth a little lead-salt and then iodide of potassium, when, if bismuth be present, a brown or crimson-coloured precipitate would be obtained instead of the bright yellow iodide of lead; in this manner one twenty-five-hundred-thousandth of a grain of bismuth could be detected. To apply this test to a specimen of copper, nitrate of lead is added to the nitric acid solution of the metal, and then ammonia and carbonate of ammonia, the precipitate dissolved in acetic acid and iodide of potassium added. Mr. Abel then said that bismuth had been discovered in a great number of copper samples, and that arsenic and silver were almost always present, but that antimony was very rarely found, and lead never, excepting in manufactured copper, such as copper bolt and sheet, and that in these cases it was intentionally added.

Dr. Odling said that he had observed that hydrogen was evolved during the solution of copper in hydrochloric acid, and that he preferred the use of chlorate of potash, to avoid the delay of exposing the liquid to the air.

Mr. Riley remarked that he had found phosphorus and antimony in copper.

The President inquired whether the amount of bismuth in the new bronze coinage had been determined.

Mr. Abel replied that the quantity was very minute, and had not, therefore, been determined.

Mr. De la Rue alluded to some analyses of commercial copper which Dr. Hugo Muller had performed; it appeared that Dr. Muller had found both sulphur and gold.

Mr. Abel said that he had succeeded in detecting gold occasionally.

The President stated that the Duc de Leuchtenberg had examined the refuse obtained from copper in the electrotype factories, and had found a great number of metallic impurities.

Dr. Muller had also examined these residues, but did not find so many constituents; the residue contained a considerable quantity of nickel.

Mr. De la Rue remarked that in the electrotype process the bulk of the copper was separated in a very satisfactory manner from the impurities, so that the residue might be easily examined.

Mr. F. Field then read a short paper *On the Occurrence of Bismuth in Various Descriptions of Copper Ore obtained from Different Parts of the World;* a table of analyses of various samples was exhibited, from which it appeared that, as a general rule, bismuth was only found in the sulphuretted ores of copper.

Mr. Newlands then exhibited a tabular arrangement of organic bodies including substances of every variety of composition, the advantage of which arrangement was that the relations between the composition of different substances was more easily discovered.

It was announced that at the next Meeting Dr. Bence Jones would read a paper *On the Occurrence of Phosphate of Lime in the Human Urine.*

NOTICES OF BOOKS.

Report of the Committee on the Decay of the Stone of the New Palace at Westminster.

CONCLUDING NOTICE.

In February of the present year, the St. Stephen's Porch of the Westminster Palace was placed under the experimental treatment of Mr. Charles Hibble, of Grafton Street, Fitzroy Square. The process employed by that gentleman was one which had received application to the private dwelling-house, No. 49, Bedford Square, early in the year 1854; and which, according to a certificate from the owner of the house had completely remedied the symptoms of decay at that time apparent in the Bath and Portland stones employed in its construction. The materials entering into the composition of Mr. Hibble's preparation are turpentine, linseed oil, Dorking lime ground, silicate of lead, and burnt copperas; the two last named being used as driers. It is preferred to apply two coats, the second containing rather more linseed oil. Another ingredient is alluded to by Mr. Hibble as having been employed upon St. Stephen's Porch; this consists of a final coating of silver sand sifted through a dredger.

The general character of the process is described and admitted to be not very different from that presented by an ordinary coating of paint. This consideration, taken together with the complex nature of the preservative

agent, has not tended towards the establishment of a very favourable opinion in regard to this process.

Another mode of applying linseed oil is communicated by Mr. P. C. Hardwick, Architect of the Bank of England. This consists in the employment of an oleaginous preparation made as follows:—Linseed oil, one gallon; soft soap, one pound to a pound and a-half; alum, half a pound; and litharge, quarter of a pound. The oil, soap, and alum, without the addition of any water, are all to be heated together in an iron pot; when melted, the litharge, wrapped in a canvas bag, is introduced, and the whole kept constantly stirred for a period of three hours over a slow fire. After cooling the mixture will have the consistence of thin paint, and may be preserved in air-tight tin canisters for a considerable time. There is a tendency, it is said, for the alum to subside to the bottom of the vessels on longer keeping; this deposit would, however, with a greater degree of probability, consist of the heavy sulphate of lead produced as the result of the action of litharge upon the sulphates in the alum.

The circumstance which induced Mr. Hardwick to advocate a trial of this composition in connexion with the Houses of Parliament, was the observation that very satisfactory results had followed the application of the same material, some twenty years since, by the foreman of works, to brick walls and buildings, including stone window-sills, on a farm in Sussex, which by this means were rendered far less absorbent of moisture, and had resisted, in a remarkable manner, the disintegrating effects of the atmosphere.

A process somewhat similar to the last is described by Mr. G. R. Burnell, C.E., a member of the Committee, as having been practised more than twenty years ago upon the dome of the Panthéon and other stone buildings in Paris. Three parts of olive oil are mixed with one of beeswax and a little litharge, generally in the proportion of about one-tenth by weight. These ingredients having been thoroughly incorporated, with the assistance of heat, are, while still hot, laid on to the surface of the stone, which should previously have been, if possible, both dried and warmed by the employment of fire-baskets or braziers. Such treatment necessarily facilitates the absorption of the oily fluid into the pores of the stone, which is thus rendered much more repellant of moisture. The instance of its application abroad, already cited, is reported to have been undoubtedly successful, so far as regards the protection of the stone; but it must be remembered that the introduction of the oxide of lead as an ingredient in this and the preceding compositions must always be attended with the disadvantages arising from the gradual darkening, by sulphuretted hydrogen in the air, of the stone surfaces so coated.

Of the processes upon which the Committee have taken evidence, the last remaining to be described is the mode of treatment patented by Mr. William Hutchinson, of St. John Street Road, for the induration of stone by immersing the blocks in melted coal-tar, pitch, or common resin, using the first or second of these substances accordingly as the colour is desired to be black or white. Some very satisfactory and interesting particulars are furnished in regard to the preparation of paving slabs, tomb-stones, window-sills, fonts, and other small architectural ornaments. These, although they may have been cut from very inferior stone, will, after their induration, have become completely impervious to water; the frost cannot affect them, and their external surfaces, originally soft, (as with the Tunbridge Wells stone, for instance,) may now have a high polish imparted to them.

In considering the applicability of such a process to stones in position, obstacles are presented which appear almost insurmountable. The high temperature required for the fusion of these substances, and the necessity for drying and even warming the stone before being brought into contact with the melted material, are difficulties which render it imperative to introduce some modification into the working of the process before it can be deemed applicable to the treatment of the Houses of Parliament.

With the present notice we conclude our critical review of the several processes which have been submitted and received the consideration of the Decay of Stone Committee; and in the ten pages of our journal devoted to the discussion of these proposals it has been our object to institute comparisons in regard to their probable efficacy as determined by an examination of the scientific principle which lies at the basis of each invention. Many of these suggestions appear worthy of extended investigation, and we entirely concur in the recommendation conveyed in the report, to the effect that it would be desirable to proceed further to a practical trial of at least one process in each class, and thus endeavour to secure without delay the opportunity of watching closely the relative capabilities of the several methods proposed, that some really valuable information may at length be acquired as to the best means of guarding our great national edifice from the ultimate and more serious consequences of confirmed decay. An important condition of such competitive trial must consist in requiring each candidate to give an explanatory statement in reference to the materials themselves and the mode in which they are about to be employed; for not only would such a course furnish a guarantee that no permanent injury to the face of the building would be likely to result from the treatment proposed, but such data must always be available for the information of those who may hereafter be entrusted with the supervision of the experimental results, and when, at the expiration of a sufficiently long interval of time, the comparative efficacy of these applications shall have been prominently developed.

Elementary Treatise on Physics, Experimental and Applied. By Professor A. Ganot. Translated and Edited from the Ninth Edition, by E. Atkinson, Ph. D., F.C.S. Part I. London: H. Baillière, 219, Regent Street.

This promises to be one of the best works on physics in the English language. The arrangement is methodical, the definitions clear and concisely expressed, and the illustrations profuse and to the purpose. The work is to be issued in monthly parts. The first part contains:—Book I. On Matter, Force, and Motion. Book II. On Gravitation and Molecular Attraction. Book III. On Liquids. It will be completed in about twelve parts and if the succeeding issues are equal to the one now before us, it will form a most valuable volume for the student.

NOTICES OF PATENTS.

564. *Cementation.* W. E. Newton, Chancery Lane, London. A communication. Dated March 5, 1861.

The Patentee claims for the cementation of iron or steel the employment of alkaline carbonates, and, particularly, also the carbonates of baryta and of strontia, mixed with a certain quantity of powdered charcoal. This process is applicable whether the operation of the furnace be continuous or intermittent, and whether the treatment be conducted in reverberatory or in ordinary furnaces, or in steel melting crucibles. Under the head of carbonates, above-mentioned, the Patentee urges a distinct claim for the exclusive use of any other salts, which, under the influence of heat and the conjoint action of carbon and the nitrogen of the atmosphere, are capable of producing cyanides, which are in reality the agents operating in the conversion of iron into steel, and constitute the special basis of this process of cementation.

The theoretical views advanced in support of the patent claim are strictly in accordance with recent investigations

upon this subject; and the important assistance rendered in the process of cementation by the employment of cyanides has long been recognised.

576. *Preserving Animal or Vegetable Matters.* A. G. Brade, Paris. A communication. Dated March 7, 1861. (Not proceeded with.)

The specification describes a new method of preserving meat, fish, vegetables, &c., by virtue of the principle of endosmosis and exosmosis, which is carried out with the further object of abstracting a portion of the water naturally contained in these substances, and of keeping the said matters, thus partially dehydrated, sufficiently protected from actual contact with the atmospheric air. The mode of accomplishing this consists in immersing the articles of food to be preserved, for a moderate length of time only, in saline solutions or other suitable materials; they are then withdrawn and allowed to become surface-dry.

It is well known that methods of preservation have been based upon the exclusion of air by coatings of albumen and gelatin, and that if the meats have previously been soaked in brine their protection is rendered more certain; but there is, on the other hand, much evidence to show that beyond a comparatively short interval of time no reliance can be placed upon stores of provisions so treated.

577. *Preserving the Aroma and other Properties of Coffee and Cocoa from the Effects of the Atmosphere.* W. Pidding, Borough Road, Southwark. Dated March 7, 1861. (Not proceeded with.)

The inventor first forms a packet of roasted and ground coffee or cocoa, or compound of either, by placing it in a mould and subjecting it to great pressure, so as to cause its particles to cohere. And after extracting such packet from the mould, he immerses it in a solution of gelatin, to which a small quantity of alcohol or methylated spirits of wine has been previously added. He then allows the prepared solution of gelatine to evaporate to dryness, and if needful dips the block of coffee or cocoa a second time, to increase the thickness of the coating, which should not be less than about one-thirty-second part of an inch. It is further recommended to surround the prepared coffee with an envelope of thin sheet gelatin, and to close the overlapping seams of this covering by moistening them with the solution of gelatin previously employed, and allowing them to dry. The objects secured by this proceeding are, firstly, the hermetically sealing the packet of coffee or cocoa as a means of preserving the aroma, and guarding against the deteriorating influence of the atmosphere; and, secondly, the gelatin will itself serve a useful purpose by refining the decoction in the process of making the coffee.

This invention is in principle very similar to that last described, and the remarks made in reference to the preceding specification are equally applicable to that now before us. It is questionable whether any external protective covering would be completely effectual in preventing decomposition or deterioration of ready-ground coffee on keeping for any length of time. The safer course, when coffee must be preserved, would surely be to roast and grind the berries as required.

583. *Improvements in the Mode of, and Apparatus used in the Process of Fermentation.* G. Hollands, Rochester. Dated March 7, 1861. (Not proceeded with.)

This invention relates to certain arrangements whereby the beer in the fermenting vats or tanks is made always to stand at the same level, which is such that the yeast continually forming in the process of fermentation may conveniently deliver itself into the yeast vat placed below, and so avoid the necessity for frequent skimming and consequently exposing the surface of the beer.

The plan of making the yeast overflow into a separate vessel placed contiguous to the fermenting tun is one frequently adopted in breweries.

593. *Apparatus for Obtaining Gas.* J. Jacob, Golden Square, London. A communication. Dated March 9, 1861.

This invention refers to the production and employment of hydrogen gas. The specific claims of the patentee are as follows:—Firstly, the process of manufacturing hydrogen gas, on a scale suited for commercial purposes, by passing steam over red-hot iron filings or borings, or iron crushed, ground, or pulverised, as described. Secondly, the heating of the retorts or generators with the hydrogen gas produced in the process, combined with air and under pressure. Thirdly, the employment of the hydrogen gas and air, combined and under pressure, for heating and lighting purposes, and for all metallurgical operations.

The preparation of hydrogen according to a plan which is found described in all Manuals of Chemistry, and which has so frequently been put into operation on a moderate scale, can scarcely, we think, constitute a valid claim for a patent right; neither does the application to heating, lighting, and metallurgical purposes possess much originality; as proof to the contrary may be mentioned—Deville's gas furnace, the oxy-hydrogen blowpipe, the lime light, and the gas soldering apparatus frequently employed in uniting the plates of sheet lead used in the construction of sulphuric acid chambers.

Grants of Provisional Protection for Six Months.

1773. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for preserving and indurating timber, wood, and other vegetable matters, and for rendering the same uninflammable."—Petition recorded July 15, 1861.

2312. Frederic Maitland Ransome and Ernest Leslie Ransome, Ipswich, Suffolk, "Improvements in treating stone, bricks, and other surfaces, and in the manufacture of filters."—Petition recorded September 16, 1861.

2335. James Cane Coombe and James Wright, Bridge Street, Blackfriars, London, "Improvements in the manufacture of stones, bricks, tiles, slabs, statuary, and such like materials, and in the method of and means for cleansing and indurating the same when employed in buildings or for building purposes, and for preserving them from atmospheric and other influences."

2348. Theophilus Redwood, Montague Street, Russell Square, London, "An improvement in the manufacture of paper."—Petition recorded September 19, 1861.

2489. Ebenezer Partridge, Patent Axle Works, Smethwick, Staffordshire, "Improvements in hardening iron and steel, and a composition or substance to be employed therein."

2525. Thomas Tidmarsh, Dorking, Surrey, "An improved artificial manure."

2526. John Schwartz, Osborne Street, Whitechapel, London, "An improvement in the manufacture of sugar."—Petition recorded October 9, 1861.

2551. Edward Thomas Hughes, Chancery Lane, London, "An improved compound to prevent the incrustation and sediments of calcareous matters in boilers."—A communication from Ernest Louis Pichio, Paris.

Invention Protected for Six Months by the Deposit of Complete Specification.

2580. William Smith, Salisbury Street, Adelphi, London, "Improvements in the apparatus for and method of increasing the illuminating power of gas."—A communication from Hugo Carstanjen, Cologne, Prussia.—Deposited and recorded October 17, 1861.

Notices to Proceed.

1543. Thomas Gray, Hill's Cottages, Union Road, Wandsworth, Surrey, "An improved method of bleaching coloured rags and vegetable fibres."

1547. Thomas Mellodew, Oldham, Charles William Kesselmeyer, Manchester, and John Mayo Worrall, Salford, Lancashire, "Improvements in dyeing and printing velvets, velveteens, and other fabrics with floated threads."—Petitions recorded June 17, 1861.

2526. John Schwartz, Osborne Street, Whitechapel, London, "An improvement in the manufacture of sugar."—Petition recorded October 9, 1861.

CORRESPONDENCE.

Specific Gravity and Solid Contents.

To the Editor of the Chemical News.

Sir,—The following samples of milk having come under my notice last week, I quote them as furnishing a very pertinent answer in the negative to your correspondent "Specific Gravity," in the Chemical News for August 10, 1861, who asks if it be possible in quantitative analysis of water, having obtained the specific gravity, to calculate from thence the total amount of solid contents in any volume, and *vice versâ*, knowing these could you not calculate the specific gravity. However easily this may be done in the case of wine as shown, it is far otherwise with water, for instance, there being no rule of proportion to guide us. No. 1 sample of milk was of sp. gr. 1·031, and yielded per thousand grains, of dried curd 78 grains, of serum 82 grains; total, 160. No. 2 sample of milk was of sp. gr. 1·033! and yielded per thousand grains, of dried curd 50½ grains, of serum 49 grains; total 99½.—I am, &c.

John Horsley.

Estimation of Alcohol in Wine.

To the Editor of the Chemical News.

Sir,—I accept, of course, without reserve, as absolute truth, the statement of Mr. Horsley in your last Number; and therefore can only point out as remarkable coincidences, that on the page (36 of Vol. I.) which contains the extract from Mulder, there is also a communication from Mr. Horsley; and further, that on page 108, and immediately following the first letter on the subject, there is again a communication from Mr. Horsley.

I am, &c. Suum Cuique.

November 12, 1861.

MISCELLANEOUS.

Chemical Society.—The next meeting of this Society will take place on Thursday the 21st inst., at Burlington House. Chair taken at 8 p.m. A paper will be read by Dr. Bence Jones "On the Occurrence of Phosphate of Lime in the Human Urine."

Phosphorus in Oysters.—Mr. James Bruce writes to the *Mechanics' Magazine* as follows:—"Some little time ago, in the opening of an oyster, I was much surprised at observing a very bright flame about the centre, which, when examined a little closer, I found to proceed actually from a small quantity of real phosphorus; the quantity I could not ascertain, but there might be half a grain. I took it from off the oyster and immersed it in water, till I had an opportunity of observing it more minutely; which, when I did, I found it to be in every respect the same as the phosphorus obtained from bones, urine, &c. The oyster itself was perfectly alive and fresh, so that it could not happen from any decomposition of the constituent parts of the shell by the aid of putrefaction; it must have proceeded from some other source. As I have never read of this substance being furnished perfectly ready-formed in Nature, any elucidation of the subject from some of your numerous readers will be very acceptable. The circumstances, moreover, may serve to explain the accidental poisoning from eating particular kinds of shell-fish; and again, those *cas rares* of 'spontaneous combustion' in the human body, as phosphorus, when heated, requires no more air than what is contained in the stomach to produce combustion which would perforate that organ."

Aureolin.—Under this name Messrs. Winsor and Newton are about to introduce to the public a magnificent yellow pigment, which supplies a desideratum hitherto in vain sought for by artists. It is the nearest approach to a perfect yellow in existence, and more closely resembles the purity of the prismatic spectrum than any other artificial colour. It is transparent, has great brilliancy and richness, both pure and in combination, and is very permanent, being entirely unaffected by exposure to sulphuretted hydrogen and other atmospheric impurities, or to the direct rays of the sun during an entire summer. Aureolin, with ultramarine and madder red, completes the triad of brilliant, permanent, and transparent primitive colours. We hope shortly to be able to lay before our readers a full description of the chemical as well as the artistic properties of this beautiful colour.

Relative Bulks of Snow and Ice.—In Sir Henry James' "Tables for the Reduction of Meteorological Observations," 1860, p. 30, are given the results of some experiments upon the conversion of ice and snow into water, conducted at Kingston, Canada West, February 28, 1854, in the presence of Lieutenant-Colonel Gordon, Lieutenant Farrell, Lieutenant the Hon. J. Bury, and Lieutenant Cox, Royal Engineers. In one experiment, one foot cube of ice was taken so pure and transparent that manuscript was perfectly legible through it. The average temperature of the block was zero, and its weight was 57 lbs. The lump was allowed to melt at a temperature of 52° Fahr., when it yielded ⅞ths of a cubic foot of water, or 1512 cubic inches, weighing 54 lbs. A corresponding experiment was then performed with virgin snow. One foot cube (1728 inches) was taken up soon after falling, and compressed into a cubic vessel; its average temperature was 19·5° Fahr., and its weight 63 lbs. 14 ozs. When melted at a temperature of 52°, it yielded 1728¼ cubic inches of water, weighing 1021 ozs., or 63 lbs. 13 ozs. These remarkable results require verification in this country.

Conglomerate Copper.—The *Mining Gazette* (Lake Superior) states that in the Portage Lake District there is a belt of conglomerate which is remarkably rich in copper. It says:—"It is a singular fact, that nearly every belt of conglomerate within the trap range in this district, and we believe in the country, has more or less copper. This is a very marked and singular mineralogical feature, and offers a field for investigation for the geologist and mineralogist, of very great interest. The conglomerate has not been, as yet, in any country, put down as a metalliferous-bearing rock, and many questions arose on the discovery of the masses in the conglomerate belt at the Minnesota mine. It is still a question whether it may yet be more than the receptacle of mineral deposited from the real metalliferous rocks adjacent, which is a point of vast importance to the true knowledge of our veins, and is of great value in determining the value of a conglomerate lode, by a close examination of the overlying belts of trap, since the lodes are always over the conglomerate and are never under them."

ANSWERS TO CORRESPONDENTS.

Beta.—The fullest account of the various combinations of phosphoric acid and lime is to be met with in Gmelin's Chemistry, Vol. 3.

Hair Wash.—G. B.—The following has been recommended for this purpose:—Tinct. Cantharid 4 drms.; sp. ammon. co., 3 drms.; glycerin, 2 drms.; ol. rosmarii, 20 minims, dissolved in sp. rectif. 1 drm; rose water or distilled water 7 ounces.

THE CHEMICAL NEWS.

VOL. IV. No. 103.—November 23, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Preparation of Urea from Ferrocyanide of Potassium, by M. CAREY LEA.

IN the preparation of urea by Wöhler's method the amount obtained always falls short of that which should theoretically be produced. Having remarked that even when the operation is carefully performed with Liebig's proportions, the lixiviate always contains undecomposed cyanide of potassium, it occurred to me to try the effect of a more thorough oxidation, and the result proved very favourable. The following was the course adopted:—

Of roasted ferrocyanide of potassium 850 grammes are mixed with 318 grammes of thoroughly dried carbonate of potash in grains, and fused in an iron vessel. When decomposition is complete, the vessel is a little cooled, and 1900 grammes of red lead are to be added, not all at once, but 300 to 400 grammes at a time, with intervals of ten minutes, stirring and keeping up heat enough to retain the whole in a state of fusion.

After the last addition of red lead the mixture is suffered to remain half an hour on the fire to complete the reaction. Heat is applied in all for about four hours. In this way the cyanide of potassium becomes thoroughly oxidised. The process is concluded in the usual manner, and 500 grammes of urea are obtained. No particular precaution is necessary during the fusion, or even the lixiviation with cold water, but in evaporating the solutions the greatest care must be taken to carry off the vapours.—*Am. Journ. of Science*, No. xcv.

On the Estimation of Tellurium, by M. H. ROSE.

Precipitation of Tellurium by Sulphurous and Phosphorous Acids.—Sulphurous acid is the best re-agent to precipitate tellurium from solutions of tellurous acid. For the precipitation to be rapid and complete, it is necessary to strongly acidulate the liquid with hydrochloric acid. Phosphorous acid, or rather phosphatic acid obtained by the slow oxidation of phosphorus in the air, can replace sulphurous acid in the precipitation of solutions of tellurous acid; the precipitation, however, is slower, even in the presence of an excess of hydrochloric acid, and the solution must be evaporated down several times successively in a water-bath to a syrupy consistency, and re-dissolved in water, to be sure of precipitating all the tellurium.

Reduction of Oxygen Compounds of Tellurium by Cyanide of Potassium.—M. Oppenheim, has already pointed out the employment of cyanide of potassium in fusion (*Journal für Praktische Chemie*, vol. lxxi., p. 279), to reduce tellurium, and to separate this body from selenium. This process does not yield the theoretical quantity of tellurium, there is always more or less loss.[1] The most correct results are obtained by fusing the oxygen compound of tellurium at a gentle heat with cyanide of potassium in a long-necked flask, through which is passed a current of hydrogen. After fusing for about ten minutes, let it cool in the current of hydrogen, then fill up the flask with water, and turn it upside down in a beaker full of the same liquid. The telluride of potassium dissolves, colouring the water red; it decomposes in the air, depositing tellurium; this decomposition is hastened by passing a current of air through the solution. The deposited tellurium is collected on a filter, and the liquid, after addition of hydrochloric acid, is treated with sulphurous acid to reduce a small quantity of tellurous acid which may have been formed.

A boiling solution of cyanide of potassium only dissolves very little metallic tellurium. Telluro-cyanide of potassium is formed in this case. From this solution tellurium is precipitated by hydrochloric acid, but not by atmospheric air.

Reduction of Oxygen Compounds of Tellurium by Fusion with Alkaline Carbonates.—Instead of cyanide of potassium, alkaline carbonates can be employed, and especially a mixture of equal equivalents of carbonate of potassa and soda mixed with an equal weight of chloride of potassium or sodium in powder. The fusion cannot be performed in a flask, on account of the high temperature which is necessary; a porcelain crucible must be used, through which a current of hydrogen is passed.

This process gives less accurate results than the one in which cyanide of potassium is used.

Estimation of Tellurium in the State of Sulphide.—Tellurous acid is completely precipitated by sulphuretted hydrogen from its hydrochloric, or even nitric solution in the state of sulphide of tellurium; this may be dried at 100° and weighed: the nitric solution must contain no nitrous acid. If there is doubt respecting the purity of the sulphide of tellurium, it must be dissolved by chlorine in the presence of a small quantity of water, taking care to pass the chlorine which has traversed the sulphide of tellurium through a second vessel of water to avoid the loss of a small quantity of tellurium. When the solution is complete, dilute the liquid and heat it, to drive off chlorine; add hydrochloric acid to make sure that there is no fresh disengagement of chlorine, for all the telluric acid which has been formed must be completely transformed into tellurous acid before the tellurium is precipitated by sulphurous acid.

Estimation of Tellurous Acid by Simple Evaporation.—When tellurous acid is dissolved in other acids, especially nitric, it can be estimated by evaporating it on the water-bath and heating the dry mass in a platinum crucible to about 200° or 270°.

[1] M. Oppenheim has since modified his process by employing a boiling solution of cyanide of potassium, and using it simply to separate tellurium, selenium, and sulphur.—See CHEMICAL NEWS, Vol. iii. p. 34.

If there is hydrochloric acid in solution, nitric acid must be added. Sulphuric acid may be completely driven off; but it is necessary to keep the mixture for some instants at the temperature of zinc.

Separation of Tellurium from Other Metals.—Tellurium cannot be separated by means of sulphide of ammonium from the metals whose sulphides are insoluble in this re-agent; tellurium always remains in the precipitated sulphides. It is necessary to employ in these cases the precipitation of tellurium from its solutions by sulphuric acid or the volatility of chloride of tellurium.

Separation of Tellurium from Sulphur.—Fuse the mixture of sulphur and tellurium with cyanide of potassium in an atmosphere of hydrogen; dissolve in water: tellurium soon separates from this solution in a metallic state. To estimate the sulphur, add potash to the liquid, and pass a current of chlorine through it, which transforms all the sulphur into sulphuric acid.

When the weight of the tellurium only in a mixture is wanted, oxidise with hydrochloric acid and chlorate of potash, heat the solution to drive off the chlorine, transform the telluric into tellurous acid by hydrochloric acid, and decomposethe tellurous acid by sulphurous acid.—*Poggendorff's Annalen*, vol. cxii. p. 307.

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, *Member of the Royal Academy of Belgium.*

(*Continued from page* 259.)

Method of determining the Proportional Relation between Silver and the Chlorides.—I will now describe how I proceed with the determination of the proportional relation between silver and the chlorides. For this purpose I followed Gay-Lussac's process for the assay of silver by the wet way. This method has been already employed by M. de Marignac and by M. Pelouze. Almost all the last memoir of M. Dumas on the equivalents rests upon the method by the wet way.

In performing this I weighed either in air or *in vacuo* a certain quantity of chloride, and calculated and weighed the quantity of silver necessary, according to Prout's law, to precipitate the chlorine contained in the chloride. I took for silver 108; for chloride of potassium $39+35{\cdot}5 = 74{\cdot}5$; for chloride of sodium, $23+35{\cdot}5 = 58{\cdot}4$; and for chloride of ammonium, $4+14+35{\cdot}5$ 53·5. The excess of silver in the liquid after double decomposition, and the amount of this excess would yield me the relation between the proportional numbers of silver and the chlorides.

This is how I proceeded with the operation:—The silver, after having been heated to redness in a crucible of the same metal and properly cooled in the air, is weighed and introduced into a white glass flask, with the stopper well ground in with emery, and having very thick sides to enable it to withstand an internal pressure of at least ten atmospheres. I then pour upon the metal ten times its weight of pure nitric acid at 25° Baumé. I put in the stopper and fix it solidly in its place by the aid of strong cord. I then surround the flask with wire gauze, and place it in a bath where its temperature is raised to 45° or 50° C. At the end of twenty-four or thirty-six hours all the silver is dissolved without any trace of gas developing itself, and consequently without anything escaping from the flask. Indeed, the binoxide of nitrogen, as fast as it is produced, reduces the nitric acid to the state of nitrous or hyponitric acids, which at this temperature remain perfectly dissolved in the large excess of nitric acid employed. If the temperature of the bath does not exceed 50°, there is really nothing to fear. I have made, under these conditions, and without any accident taking place, upwards of a hundred solutions of silver in a closed flask, employing from three to fifty grammes of silver at a time. Twice only, the temperature of the bath rising much too high, two flasks which were immersed in it yielded to the internal pressure and produced a rather violent explosion. I have had recourse to the solution of silver in a close vessel, because I have come to the conclusion that the method of solution in open vessels such as is adopted in the assay rooms of the Mint causes a slight loss of silver. I have seen assayers of proved skill obtain in three assays of the same silver results presenting greater differences than the errors which are due to the admirable method of Gay-Lussac. The same fact presented itself to me when I wished to familiarise myself with this process to prepare myself for the determinations. Moreover, the constant presence of silver in the washing-waters of the gas, arising from the solution of the metal during my syntheses of the nitrate and chloride of silver, sufficiently point out the necessity of effecting this solution either in a close vessel or in apparatus in which the escaping gases may be washed. I ought to add, however, that the loss experienced upon a gramme of silver never affects the accuracy of the assay of silver in the Mint, owing to the much more considerable and unavoidable error of experiment.

The solution of the metal having been effected, and the flask well cooled, I introduce such an amount of pure water that, with the acid already added, the total weight of the liquid becomes at the minimum thirty-five times, and at the maximum fifty times the weight of the silver employed. I now carry the flask into a dark room lighted with gas. After having conveniently inclined it, I introduce into it a tube, sealed up at one end, fixed to a rod of platinum, and containing the chloride weighed with the greatest accuracy which my balances will admit of. I then drop the chloride into the solution of silver, and wash the tube out several times with water, so as not to lose the traces of chloride which may remain adhering to it. After having tightly closed the flasks, and enveloped it in caoutchouc, I shake it until the liquid, at first turbid, becomes perfectly clear. I then proceed to the assay of the silver remaining unprecipitated. For this purpose, I have prepared with the greatest care the decimal solutions of salt and silver, such as are employed in the laboratories of the Mint.

On the other hand, I have myself manufactured pipettes, tubes which, when empty in a vertical position, would furnish me ten, five, four, three, two, one, or half a cubic centimètre of decimal solution. I also constructed bourettes, which, when placed in a vertical position, would deliver drops exactly equal to the twentieth of a cubic centimètre. The bourette itself and the tubes of half, one, and two centimètres, are subdivided into twentieths of a cubic centimètre. The small bourette consists of a graduated tube of four or five millimètres, internal diameter, drawn out to a point so as to expose an opening of about one millimètre in diameter, and melted to a larger open tube, the aperture of which is covered with a piece of vulcanised caoutchouc folded over the side of the tube, and more or less strongly bound to it, according as it is wished to deliver the drops more or less rapidly: my bourettes would only give five or six per minute.

It is absolutely necessary to hold the bourettes in a vertical position, for the same instrument which furnishes with the greatest accuracy twenty drops per cubic centimètre only delivers seventeen or eighteen when it is inclined 45°; in a position of 10° or 15° no more than sixteen or seventeen drops are required to make a centimètre.

To perform the assay, I had besides the following arrangement:—In a long narrow box, the anterior portion of which was furnished with yellow glass, and the posterior portion lighted by a gas lamp, I arranged a perfectly spherical glass globe containing a saturated solution of the double chromate of potash and soda, so as to concentrate the rays and obtain a cone of yellow light. I then place the flask containing the assay in such a position that the surface of the liquid may be traversed by the beam of yellow light. To make an observation, I place myself so as to make an angle of 60° with the luminous ray traversing the flask. When this artifice is employed, a liquid containing two milligrammes of silver per litre produces a yellow opaque and dull precipitate of chloride of silver, when half a centimètre of decimal solution is allowed to fall carefully upon its surface; when the quantity of silver is reduced to one milligramme, the precipitate of chloride is yellow, opaque, and brilliant; when the liquid is diminished in strength, so that it contains no more than the twentieth of a milligramme of silver per litre, there is still produced an appreciable cloud upon the addition of a corresponding quantity of decimal solution. It is only necessary to wait sufficiently long, without touching the flask, to be certain of it. Nevertheless, in these assays I have only worked to tenths of a milligramme.

In all my experiments I have continued adding decimal salt solution as long as I have seen a cloud produced on the surface of the liquid after standing fifteen minutes. When I have arrived at the extreme limit, and have just passed it, I add five centimètres of decimal solution of silver. After well shaking, I neutralise three-quarters of the excess of silver, so as to obtain immediately upon agitation a clear liquid approaching very nearly the extreme limit. When there was a difference between the results of two assays, a difference that has never exceeded two or three tenths of a milligramme, I always took the minimum result.

Those who have made many assays by the wet way will have noticed that the interior sides of a flask in which they have shaken for some time chloride of silver produced by successive precipitation, becomes covered with a kind of varnish of chloride, appears greasy, and so loses its transparency. To obviate this inconvenience when it occurs, I remove, by means of a pipette, a portion of the liquid after it has been agitated and become limpid by standing sufficiently, and transfer it to a bottle having parallel sides of crystal, and ascertain in this second bottle the presence of silver or salt in excess. The liquid in this bottle was always added to the first whenever it was found necessary to continue the operation.

The assay presents another difficulty which may lead one greatly in error when not forewarned of it.

A liquid from which there has been precipitated by a saline solution almost all the silver, but which still contains between one and two milligrammes of silver per litre, is precipitated equally upon the addition of a decimal solution of silver or of salt. In this case, however, there is a very evident difference in the resulting turbidity. The precipitate occasioned by the decimal salt solution to the assay containing one or two milligrammes of silver in the state of nitrate is always opaque, yellow, and brilliant; whilst the precipitate formed upon the addition of nitrate of silver to the same liquid is whitish and translucid. I account for this anomaly by the slight solubility of chloride of silver in the alkaline nitrate in solution, and which precipitates in the presence of a silver solution richer than itself. I have, notwithstanding, always added decimal salt solution until precipitation ceases.

Such is the method of assay which I have adopted for all my determinations by means of double decomposition.

I now return to the chloride of potassium.

I have made two series of determinations: the first was performed nearly three years before the second. I separate the results because three of the five experiments composing the first series were performed with silver prepared by Gay-Lussac's process. The silver of Number I. underwent one treatment, that of Number II. two treatments, and that of Number III. three treatments. This silver is not pure, as I have already said; but, as I carefully ascertained the standard of that which I employed, by comparing it with metal obtained by electrolysis, or by Liebig's process, I was able to submit its weight to the necessary corrections. These three determinations show better than any argument how much impurity in the metal can affect the result. It is only with this object that I publish them. The nineteen

Proportional Relation between Silver and Chloride of Potassium.

First Series.

Numerical Order.	Weight of the Chloride of Potassium in air.	Weight of the Chloride of Potassium reduced to a vacuum.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the Silver after allowing for impurities.	Weight of the excess of Silver after double decomposition.	Weight of Chloride of Potassium corresponding to the excess of Silver.	100·000 parts of Silver correspond to Chloride of Potassium: A. Calculated from the weight of the crude metal.	100·000 parts of Silver correspond to Chloride of Potassium: B. Calculated from the actual weight of the metal.
	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.		
I.	7·4461	7·450	10·8004	10·800	10·7976	0·0169	0·0117	69·0898	69·105
II.	7·4461	7·450	10·8004	10·800	10·7983	0·0173	0·0120	69·093	69·104
III.	7·4461	7·450	10·8004	10·800	10·79914	0·0182	0·0126	69·098	69·103
IV.	7·4461	7·450	10·8004	10·800	10·800	0·0191	0·0132	69·104	69·104
V.	7·4461	7·450	10·8004	10·800	10·800	0·0189	0·0131	69·102	69·102
								Mean.	69·1036

Proportional Relation between Silver and Chloride of Potassium.

Second Series.

Numerical Order.	Weight of the Chloride of Potassium in air.	Weight of the Chloride of Potassium reduced to a vacuum.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the excess of Silver after double decomposition.	Weight of Chloride of Potassium corresponding to the excess of Silver.	100·000 parts of Silver correspond to Chloride of Potassium.
	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.	
I.	2·09325	2·09450	3·03618	3·03636	0·0055	0·0038	69·105
II.	1·98565	1·98685	2·88010	2·88028	0·0050	0·0034	69·099
III.	4·4759	4·4786	6·4920	6·49240	0·0115	0·0080	69·107
IV.	4·7013	4·7041	6·81890	6·81930	0·0121	0·0084	69·103
V.	7·08925	7·09352	10·28258	10·28320	0·0185	0·0128	69·103
VI.	8·8827	8·88805	12·8839	12·8847	0·0230	0·0159	69·105
VII.	9·65585	9·66160	14·0053	14·00615	0·0245	0·0168	69·104
VIII.	8·0961	8·10100	11·74300	14·74373(1)	0·0202	0·0139	69·099
IX.	22·3365	22·3500	32·3980	32·4000	0·0572	0·0395	69·1034
IXa.	4·1246	4·12706	5·98248	5·98285	0·0106	0·0074	69·104
IXb.	3·2632	3·26516	4·73310	4·73338	0·0083	0·0057	69·103
IXc.	5·8849	5·88845	8·53575	8·53627	0·0149	0·0103	69·102
IXd.	5·1692	5·17232	7·49765	7·49812	0·0131	0·0091	69·104
X.	3·83185	3·83415	5 55790	5·55823	0·0097	0·0067	69·104
Xa.	3·8425	3·84461	5·5730	5·5734	0·0099	0·0069	69·105
Xb.	4·1910	4·19350	6·07880	6·0792	0·0108	0·0074	69·103
Xc.	5·17925	5·18237	7·51220	7·51267	0·0130	0·0090	69·101
Xd.	3·58975	3·59191	5·20670	5·20700	0·0092	0·0064	69·105
XI.	7·2525	7·25682	10·51930	10·51995	0·0194	0·0128	69·103
						Mean . . .	69·103

(1) Thus in the original paper: it is evidently a misprint for 11·74373.

experiments composing the second series are more than sufficient to establish the true proportional relation between silver and chloride of potassium.

The last two determinations of the first series were performed with silver obtained, in Number IV. with divided phosphorus and an excess of pure nitrate of silver, and in Number V. by the decomposition of acetate of silver crystallised a great many times, and, moreover, prepared with silver previously purified.

The chloride of potassium employed in the five determinations of the first series was the same, and was derived from the analyses of chlorate of potash, which I describe further on. The traces of silica and alumina were separated from it by the means already given. The solution was neutral, and yielded a liquid of absolute limpidity.

The silver employed for the determinations of the second series has been prepared either by electrolysis or by Liebig's process, or by the decomposition of pure chloride with carbonate of soda. All the silver was compared with the purest which I had been able to procure by the methods already indicated. The metal employed in experiment Number VII. was prepared by M. Liebig.

TECHNICAL CHEMISTRY.

On the Occurrence of Gold in Wales, by T. A. Readwin, *Esq.*[1]

I shall confine my observations in this paper to an area of about twenty square miles, situated north of the turnpike road leading from Dolgelly to Barmouth. Professor Ramsay has so ably described the geology of this district, in a communication to the Geological Society of London in 1854, entitled "The Geology of the Gold-bearing Districts of Merionethshire," that I shall merely refer to its geology for the information of those present who have not perused the communication referred to. The Dolgelly district is bounded by the river Mawddach, the great Merioneth anticlinal range, and the little river Camlan. In this district are found the Cambrians, overlaid by the lower Silurian lingulas. The Cambrian rocks are coarse greenish-grey grits, and the lingula flags are arenaceous slaty beds, interstratified with courses of sandstone. Calcareous and greenstone dykes frequently penetrate both the Cambrian and the Silurian rocks. The metalliferous products are chiefly argentiferous galena, copper pyrites, blende, manganese, and mundic, associated frequently with gold. According to Sir R. Murchison, the most usual position of gold is in quartzose veinstones that traverse altered palæozoic slates, frequently near their junction with eruptive rocks, whether of igneous or of aqueous origin. The stratified rocks of the highest antiquity, such as the oldest gneiss or quartz rocks, have seldom borne gold; but the sedimentary accumulations which followed, or the Silurian, Devonian, and carboniferous (particularly the first of these three), have been the deposits which, in the tracts where they have undergone a metamorphosis or change of structure, by the influence of igneous agency or other causes, have been the chief sources whence gold has been derived. After referring to the opinion of Professor Ramsay that gold in the Ural Mountains, Australia, &c., occurred in rocks of a similar age and character, Mr. Readwin continued: Sir R. Murchison's statement is

[1] Read before the British Association.

singularly corroborated by the position of the quartzose vein in the Clogau Mine, distinguished as the "gold lode," which traverses altered palæozoic slates, near the junction of an eruptive bar of porphyritic greenstone; and the same law appears to obtain, also, with respect to all gold-bearing quartzose veins of the Dolgelly district, upon the ores of which I have made a very large number of experiments during the past eight years. There are in this district about twenty localities in which gold has been discovered visible, in quartz or associated, more or less with galena, blende, copper pyrites, telluric-bismuth, carbonate of lime, schist, baryta, iron pyrites, &c. By far the richest discoveries of gold have been made at the Dol-y-frwynog, Prince of Wales, Cambrian, and the Clogau mines. Gold has also been found in the "marine drift" by the Hon. F. Walpole, Sir Augustus Webster, myself, and others, a piece of which is now on the table. Mr. Arthur Dean, in a paper read before the British Association in 1844, stated that a complete system of auriferous veins exists throughout the whole of the Snowdonian or Lower Silurian formations of North Wales. Upon the faith of this, much money was spent at the Cwmheisian mines, and very little gold obtained by smelting operations, for reasons which are now not very difficult to understand. Much money was also spent about ten years afterwards at the same place, after setting the most eminent assayers to work to prove the truth of Mr. Dean's statement, in erecting machinery, which produced even less gold by amalgamation than the former method; although it was then held as an axiom, that gold always exists in a metallic state, that mercury has always an affinity for gold, and, therefore, wherever gold is present in minerals mercury will necessarily dissolve it. In this instance, however, this did not prove the case, and the result of operations upon 150 tons came at length to be considered as an enigmatical failure, as the following extracts from the experiments made at the time will show. [Here followed a detailed account of experiment No. 7, made on $4\frac{1}{2}$ tons of metalliferous minerals, which was triturated in 42 lbs. of mercury.] Ten pounds of this, on distillation, gave 70 grains residual metal, containing 18·4 grains of gold. A qualitative analysis of this residual metal gave gold, silver, lead, bismuth, zinc, arsenic, and also traces of copper and iron. The distilled mercury contained traces only of zinc and arsenic. It had been proved before the experiment, and also since, that the $4\frac{1}{2}$ tons of mineral contained several ounces of this "royal metal," but the quicksilver neglected it for associates of less dignity, though intrinsically of more real utility. This, however, was not the result expected. At the Dol-y-frwynog mine, about two years afterwards, Sir Charles Price operated similarly upon several tons of material, but with the same provoking failure as before. At present the Clogau mine is the most interesting and profitable. It stands at an elevation of 1000 feet above the level of the sea. The "Saint David's," or "Gold Lode," is the most remarkable feature. After giving some interesting descriptions of this mine, the author desired to notice especially that this lode is at the junction of the Cambrian sandstones and the lingula flags of the Lower Silurian rocks. A quantity of what was called "poor copper ore;" was raised from this lode and sold many years since; but in 1854 the refuse of this "poor copper ore" was examined, and indications of "native gold in considerable quantities" were found. Some of this refuse ore was put to the test, and in one instance, to his knowledge, 100 lbs. weight yielded $14\frac{1}{2}$ ounces of gold. Many other experiments have been made by various persons with equal success, but owing to the uncertainty of the operation of amalgamation, on the one hand, and the mines themselves being subject to two Chancery suits on the other, the general value of the lode, in bulk, has not until recently been determined. After some observations on the processes of assay,—which he did not think would give the approximate value of auriferous minerals, notwithstanding that the contrary had been asserted by many eminent men,—the author referred to a series of thirteen experiments, made by himself last autumn upon 112 lbs. of auriferous quartz from the Clogau Mine, duly prepared and sampled by Johnson and Son, of London. The whole quantity gave 25 oz. 16 dwts. 7 grains of amalgam, and of fine gold, 8 oz. 5 dwts. 19 grains. A gentleman of high standing in such matters had declared the value of the gold by assay to be 9*l.* per cwt., while he (Mr. Readwin) declared it to be 30*l.*, so he (Mr. Readwin) happened to be right, as he had operated upon samples of 7lb. each, instead of the usual 400 grains. He would now state the result of actual working operations for gold at the Clogau Mine since the beginning of the year. This statement showed that 207 tons 8 cwt. of quartz gave 1314 ounces of fine gold; 3 tons of the best of this quartz gave no less than 976·6 ounces of gold. If they added 56 ounces obtained from 5 tons in 1860, it showed a total quantity of 1370 ounces of gold from 212 tons of auriferous mineral, being at the rate of $6\frac{1}{2}$ ounces per ton. This he believed was the first instance of a hundredweight of gold having been obtained from the Crown lands of this country, the value of which was 5300*l.* This "Royal mine" paid a royalty of $\frac{1}{12}$th to the Crown. The cost of extraction had been very inconsiderable, and there was a probability of an equal yield of gold for some time to come. Mr. Readwin concluded by saying:—Seven years ago I determined, unwisely perhaps, never to leave this vexed question until I had mastered it. I have done so. Experiments are ended, works are the result of faith, and, after great wear of both mind and body, I have proved what many then doubted, and many more derided, that gold does really exist in the Dolgelly district, and that it can be extracted from the minerals in remunerative quantity. I am very glad to have had the opportunity of stating this to the British Association, under the presidency of the sagacious Director-General of the Geological Survey of Great Britain.

Mr. Jukes said he was sure they were all much obliged to Mr. Readwin for his very clear and lucid statement relative to the gold in North Wales. They had long known of its existence, but not that it existed in sufficient quantities to render its production remunerative.—Professor Smith, of Sydney, Australia, asked Mr. Readwin by what process he separated the gold from the quartz?—Mr. Readwin: Chiefly by amalgamation, taking care not to intrude any mineral that would have the effect of neutralising the mercury, as galena or copper pyrites, &c.—Professor Smith inquired whether some of the mercury was not lost in the process?—Mr. Readwin stated that some of the mercury was always lost; it became so finely divided that some of it was sure to be carried away.—Mr. Smith said he perceived that in old North Wales they were falling into the same difficulty as their friends in New South Wales. There were many things which would have a singular action upon mercury, and likely to injure its effect on the gold. The action they had was a chemical one, and, therefore, the gold-producers of New South Wales had depended, to a great extent, upon mechanical action exclusively, and generally they had been very successful. If anyone

could point out any means by which gold could be satisfactorily separated from the quartz, it would be a great boon. The mechanical means they employed in New South Wales would leave only half-an-ounce per ton, which was considered very fair. The production of gold in old North Wales, as detailed by Mr. Readwin, surprised him very much. The yield of gold in Victoria or New South Wales did not exceed one ounce per ton of quartz, and in many instances half-an-ounce was considered a fair yield. The digger of Australia would be extremely proud to get it in such quantities as six ounces per ton, as Mr. Readwin had stated the yield of the Dolgelly quartz to be. From three to four ounces per ton would be considered very good anywhere in the gold districts of Australia. In some small localities the yield had been as high as thirty ounces, forty ounces, or even more, per ton, but they were exceptional, and did not last long.—In answer to another question, Mr. Readwin stated that the actual cost of obtaining the 1300 ounces of gold was under 300*l.* He did not wish there to be any misunderstanding as to the yield of gold, for taking an average of the whole auriferous district of Dolgelly, he did not suppose the yield would be above half-an-ounce per ton.—A gentleman asked what was the cost per ton of crushing the quartz?—Mr. Readwin said that as they worked only by water power, the cost of crushing per ton would be less than half-a-crown.—Professor Smith expressed his surprise, as the cost per ton in Australia was calculated on an average at 1*l.* per ton. He referred to the fact that most of the firms there used the Cornish stampers for crushing the quartz, and that it answered its purpose well.—Mr. Readwin did not approve of the stampers, as he had found gold washed away after their use.

PHARMACY, TOXICOLOGY, &c.

On the Employment of Arseniuretted Alcohol for the Preservation of Objects of Natural History, especially Insects, by M. LEPRIEUR.

AT the ordinary temperature pour 500 grammes of rectified alcohol, weighing at 94 per cent. on an excess of opaque arsenious acid. After eight hours of contact, during which time the liquid is frequently shaken, the alcohol is filtered. Upon evaporating 200 grammes of the solution in a platinum capsule over a water-bath, a residue is left weighing 0·03 grammes, or 0·15 grammes per kilogramme. On employing alcohol at 85 per cent. a residue is left of 0·102 grammes, or 0·51 grammes per kilogramme. If the alcohol at 85, and the arsenious acid, are kept in contact for four months, the residue weighs 1·38 grammes per kilogramme.

To be as energetic and complete as possible, the action of the arseniuretted alcohol should take place on tissues very recently deprived of life: it is, consequently indispensable in the case of insects, for example, that they should be immersed in it whilst still alive, or, better still, after having been asphyxiated with the vapour of ether, chloroform, or benzole. Some of them, indeed, must not be immersed living in even pure alcohol, for as soon as they touch the liquid they open their elytra and spread their wings as if they wished to fly away.

Almost all the coleoptera, the hemiptera, and even the orthoptera, can be plunged without danger into the arseniuretted alcohol, provided they are not left in longer than ten or twelve hours; after this time they must be taken out of the alcohol and thrown upon blotting-paper, then they are to be pricked or cemented down until they have lost by evaporation the greater part of the liquid.

When the insects have been allowed to dry before being plunged into arseniuretted alcohol, the action of the latter is not so efficacious; when a collection is much attacked by larva, recourse must be had to an immersion for twelve hours.

Of all the methods which have been proposed to preserve collections, this is, according to M. Leprieur, the best. He has employed arseniuretted alcohol for twelve years, to the exclusion of all other means, and with uniformly good results.

It follows from M. Leprieur's experience that living insects, plunged into arseniuretted alcohol, and removed after remaining there for twelve hours only, increase in weight by about one-fourth; insects, therefore, preserve in their organs an amount of arsenious acid about equal to $\frac{3}{1000}$ of their own weight, a quantity quite sufficient to protect them from destruction by larvæ.

According to M. Leprieur, the employment of an alcoholic solution of arsenious acid possesses the advantage of preventing, in an almost absolute manner, the ravages of larvæ, whilst all other means, whatever be their efficiency, can have no other result than the actual destruction of the larvæ already present in a collection, without having any power to protect them from future, ravages.—*Journal de Pharm. et de Chim.*, vol. xxxix. p. 435.

PHYSICAL SCIENCE.

On Phosphorescence, by M. DE REICHENBACH.

THE experiments of M. De Reichenbach tend to prove that phosphorescence is a usual consequence of all molecular phenomena, and not the result of combustion or oxidation. Mr. Phipson proved this last point some time ago, when he showed that dead fishes shine in the dark, even under water, and in the absence of oxygen.

According to M. De Reichenbach there is phosphorescence during fermentation or putrefaction, crystallisation, evaporation, condensation of vapours, the production of sound (vibrations therefore), and the fusion of ice; a considerable glow is remarked when a galvanic pile in activity, a block of ice in fusion, or a solution of sulphate of soda in the act of crystallising is observed in the dark.

The human body itself is not devoid of phosphorescence: in a healthy state it emits a yellow glow; when in ill-health the glow becomes red. The author considers that this observation may possibly be of use in diagnosis.

To perceive these phenomena the eye ought to have been previously rendered sensitive by remaining some hours in perfect darkness, and even then all eyes are not equally impressionable. But, if several persons unite in performing the experiment together, there will always be a certain number who are able to see the phenomena.

These facts of the production of light remind the author of observations published some time ago, by M. Wullner, according to which every molecular movement is accompanied by a disengagement of electricity.—*Poggendorff's Annalen*, vol. cxii., p. 459.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

Wednesday, November 6, 1861.

Mr. P. Squire, President, in the Chair.

Professor Bentley exhibited a specimen of the Ordeal Root spoken of by M. du Chaillu in his book on Western Africa. It is there said to be in use among some African tribes as a test for witchcraft—an individual suspected of that crime being required to imbibe a strong infusion of the root. It is intensely poisonous, and if the individual dies he is supposed to have been guilty, but if, from any cause, he should survive the ordeal, he is considered innocent. The observed effects of the poison, and the character of the bark on the root, the Professor said, left no doubt on his mind that it was derived from a species of strychnos.

Mr. Brown received the silver medal of the Society for a magnificent herbarium, consisting of 776 specimens of British plants. Several of the specimens were exhibited, and the preservation and mounting of the plants excited great admiration.

The President then read a Paper *On Medicinal Extracts, taking Extract of Belladonna as an Example.* The object of the Paper was to point out that the process for the preparation of the so-called green extracts, given in the London Pharmacopœia for 1851, was never followed by the manufacturers of those extracts on a large scale; and, further, that the plan which is adopted by the manufacturers is decidedly the better. Mr. Squire tested the different processes with some belladonna. The plant arrived at maturity in September this year, and was then cut, and immediately used. From this plant three extracts were made, one from the leaves only, as directed in the Pharmacopœia, another from all the soft parts (the plan adopted by the manufacturers), and a third from all the soft parts except the leaves. The first became mouldy in ten days. Both the others were good extracts, which kept well. To test the effects of the extracts, Mr. Squire placed specimens in the hands of some eminent ophthalmic surgeons—Mr. Wordsworth, Mr. White Cooper, and others—for trial, and they all reported that the extract made from the soft parts without the leaves acted most powerfully and rapidly in dilating the pupil of the eye. Mr. Squire concludes, therefore, that the most active and best keeping extract is made from the whole of the soft parts of the plant—a fact which applies to extract of henbane and other green extracts as well as belladonna. Another reason for adopting the manufacturers' plan was, that when the Pharmacopœia process was followed, there was a loss of one-third of the useful constituents of a plant.

Mr. Deane said that *à priori* it was a serious mistake to reject the succulent stalks of plants like belladonna in making extracts, for the sap passed from the leaves to the stems, and there formed active substances. And this was the case, not only in succulent, but woody stems, and even roots, as had just been shown in the ordeal root. He had made extracts in all sorts of ways, evaporating *in vacuo*, by continuous boiling, and by evaporation at a low temperature; and he found that an extract evaporated without coagulating the albuminous matter kept without moulding if the plant was gathered in proper condition, but if the albuminous matter was coagulated, the extract became mouldy in a short time. An extract boiled down he also found to keep well and exhibit no tendency to mouldiness; and further, there was not the same disposition to ferment as was sometimes seen in extracts made at a low temperature. A great point in making a good extract was to make use of the plant at once before any heating took place. The effect of this heating was well shown in the case of tea, the difference between black and green tea simply being, that in the former the leaves were allowed to heat before they were dried, and to make green tea the leaves were dried as soon as picked. Some change of the same sort took place in all plants, and the best and most elegant extracts were made from herbs gathered at the proper time and not allowed to heat. Plants in incipient inflorescence, or even one-third flowered, were unfit for extracts. The older they were, the less albuminous matter they contained.

Mr. Heathfield said that the juice from stalks contained as much active matter as that from leaves. Fermentation, he said, took place in extracts where chlorophyll was absent, as in the extracts of broom, colchicum, and poppies; but when chlorophyll is present it never takes place. An extract from the stalks alone he found to liquefy soon. He agreed with Mr. Deane that the best extract was made from a plant of which the flowers were fully formed, and all the soft parts, leaves, flowers, seed-vessels, and branches were used. Such an extract would keep good an unlimited time. In 1831 he experimented with the juice of hemlock. He separated the albuminous matter and chlorophyll, and found that these in summer weather moulded very soon, while the juice kept well. In examining the juice to try and discover what had kept it, he found a considerable amount of chloride of sodium, which he believed was the cause. He had found no difference in the keeping properties of extracts made at different temperatures.

Mr. Francis said he always used all the soft parts of the plants. The best extracts were made by evaporating in-doors to the consistence of treacle, and finishing out in the sun. In that manner an extract was obtained of the finest flavour, and which would not become mouldy. It was a mistake to make green extracts; they were brown when made in the sun.

Mr. Haselden said he had made extracts according to the Pharmacopœia process, which he found to keep very well, and have the true aroma, but which had not the consistence of extracts made from the whole plant. They absorbed moisture, and were unfit for making pills.

Mr. Holland said that, as a large manufacturer, he had found it dangerous to allow the plants to ferment before making the extracts. He used all the soft parts that could be easily broken by the hand. He had noticed that the chlorophyll separated at one heat, and the albuminous matters at another.

Professor Bentley said that practical men, without an exception, never made extracts from the green leaves alone, but used all the parts of a plant in close contact with the leaves, which were essentially the same as leaves. The Pharmacopœia process could not be followed because an extract made from the leaves never kept, but became mouldy in a few weeks. Allowing the plants to heat was highly objectionable. The extract should be made immediately after the plants were gathered.

Mr. Hills read some statistics. From about 1 cwt. of the belladonna plant, of which perhaps three-quarters were thrown away, he in the following years obtained the following amounts of extract:—1859, 1lb. 9½ozs.; 1860, 1lb. 10½ozs.; 1861, 2lbs. 4ozs.

The further discussion of this subject was adjourned until the next meeting.

Mr. Furley then exhibited his "Process for Rendering Pills Tasteless." He was provided with two saucers. Into one of these he put some powder composed of equal parts of tragacanth and sugar. The inside of the other he smeared with white of egg which had been well shaken and poured away from the froth. The pills were first placed in this latter saucer, which was then moved rapidly round and round, causing the pills to revolve within, by which means they in a second or two became covered all over with a film of albumen. They were then transferred to the other saucer and again made to revolve in the

powder, which now adhered to the albumen, and so the pills became coated with a mixture of tragacanth and sugar.[1]

Mr. Attfield afterwards exhibited, and explained the principle of, Casella's Minimum Thermometer, an account of which instrument has already appeared in the Chemical News.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 12, 1861.

Dr. R. Angus Smith, *Vice-President, in the Chair.*

Mr. Thomas Coward was elected an ordinary member.

Mr. E. W. Binney said that some years since he read a paper before the Society, "On the Drift Deposits found near Blackpool," which was afterwards printed in Vol. X. (new series) of the Memoirs. In the gravel at Bispham, most probably the high level gravel of Mr. Prestwich, he found nineteen species of shells, all identical with those now found in the Irish Sea. He also stated that in the lowest bed of till there found, full of scored and striated rocks, he collected shells of the genera *turritella*, *buccinum*, *nassa*, *dentalium*, *nucula*, *cardium*, and *tellina*. Owing to such shells found in these deposits not having so arctic a character as those said to be found in other till beds, it has been supposed that they are of a more recent date than the glacial age of Forbes, or the pleistocene of Lyell. Professor King, of Queen's College, Galway, a geologist of high reputation, in his Synoptical Table of British Aqueous Rock Groups, &c., just published, classes the Blackpool fossils with post-pleistocene, as shell sands occurring just under deposits now forming around the shores of the British Islands, and immediately above the Devonshire raised beaches. The Blackpool gravels, near Bispham, are as good pleistocene as can be found in any of the high level gravels met with further inland, notwithstanding the fossils discovered in them, which are of the same kind, although not so numerous, as those met with in the gravels of Bowdon, Cheshire, and the sands of Haigh, Lancashire. He also said that the lowest bed of till seen at Blackpool, and containing the shells previously alluded to, had all the physical characters of the Scottish, Irish, and North of England iceberg and glacial drift, and had been subject to considerable elevations since its deposition.

Mr. R. D. Darbishire stated that he had lately found under undisturbed clay at a considerable elevation on the southerly slope of Great Orme's Head, a deposit of bones of different mammalia intermixed with shells of mytilus, littorina and patella. He hoped to lay the results of further observations before the Society on a future occasion. He supposed the deposit might be connected with the present or past existence of some "bone cave" in the limestone rock of the Head. He suggested, however, that possibly the bones and shells may have been the remnants of the cookery of former inhabitants of the district, and referred, in illustration, to the researches made amongst the Kjokkenmöddings on the coasts of Denmark.

Dr. Joule, in reference to speculations on the thickness of the earth's crust, stated that he had some time ago received a letter from Professor Thomson, giving an account of the progress of investigations calculated to throw light on this interesting subject. Professor Thomson finds that the equilibrium lunar tide in a solid glass globe (without mutual gravitation) of the same size as the earth is about five feet. Hence, from the phenomena of the actual tides of the ocean, it follows that the earth, as a whole, is more rigid than glass. The observations of Mallet, with experimental earthquakes, show that the earth's crust is many times less rigid than glass. Hence Professor Thomson infers that the earth, as a whole, is many times more rigid than the rocks and strata on its surface.

Dr. Crace Calvert stated that he wished to draw the attention of the manufacturing chemists of this district to a very simple and rapid method which had been devised by the eminent chemist M. Pelouze, Master of the Paris Mint, for determining the amount of sulphur existing in pyrites. He (Dr. Calvert) was induced to do so, believing that any process which would simplify the long and troublesome operations now followed to ascertain the value of this mineral would be useful to many members now present at this meeting. The process consists in mixing intimately together one part of pyrites, thoroughly pulverised in an agate mortar, with five parts of carbonate of soda, seven parts of chlorate of potass, and five parts of chloride of sodium, and placing the whole in an iron spoon, which is gradually carried to a dull red heat. The mass, when cold, is first washed with cold water and then with boiling water, until the whole of the soluble matter is removed; and this solution is tested with a standard solution of sulphuric acid. As 100 grains of carbonate of soda requires 92·45 of monohydrated sulphuric acid, or SO_3HO, it follows that the quantity of soda in the carbonate of soda employed will decrease in proportion to the quantity of sulphur from the pyrites converted into sulphuric acid, which will have neutralised a corresponding quantity of the soda in the carbonate.

This mode of assaying is so simple, that the Author states that he can determine, within one or one and a-half per cent., the value of a sample of pyrites, in the space of an hour's time.

M. Pelouze also states that by employing the following proportions of the same materials, the manufacturer can determine the amount of sulphur in burnt pyrites. Five parts of the latter substance are mixed intimately with five parts of pure carbonate of soda and five parts of chlorate of potash.

NOTICES OF PATENTS.

595. *Iron.* W. H. Buckland, Barge Yard, Bucklersbury, London. Dated March 9, 1861.

This patent refers to the smelting or reduction of iron from the ore by the employment in the smelting furnace, crucible, or other receptacle, of a bath of melted cast-iron, into which the heated or semi-fused particles of ore may fall, and in consequence of being entirely surrounded by the fluid metal, become more quickly melted and reduced.

In the process of smelting iron in the ordinary blast furnace, a cistern is provided for the reception of the liquid iron, into which the metal runs freely, as produced, such arrangements having been devised as a means of maintaining a clear passage for the blast, and of permitting the ore not yet reduced to be surrounded by, and subject to, the uninterrupted action of the carbonic oxide gas generated in the hottest part of the furnace. According to the system now described, this potent action of the reducing gases cannot be exerted.

612. *Dyeing and Printing Textile Materials and Fabrics.* R. H. Gratrix, Salford. Dated March 12, 1861. Not proceeded with.

This invention relates to the printing and dyeing of colours derived from aniline, nitro-benzol, naphthaline, cinchonine, and analogous substances. The inventor

[1 Having given our readers the above information, we feel bound to add, by way of caution, that Her Majesty, "being willing to give encouragement to all arts and inventions which may be for the public good," has been graciously pleased to grant Royal Letters Patent to the inventor, his executors, administrators, and assigns, for the sole use, benefit, and advantage of the above invention. The Patentee, however, in consideration of a small sum, grants a licence for its use, and the apparatus required is ridiculously cheap.—Ed. Chemical News.]

produces a fast dye by passing cloth prepared with stannate of soda or other suitable mordant, through a thickened solution of tannin, and, after the ordinary dyeing, subjecting it to the fixing action of steam. After washing out the gummy matters, and drying, the material may then be dyed with any of the colours specified above. Or cloth or yarn, prepared as directed, may be passed through an acid or other solution of tannin, mixed with the colour intended to be used. Also, the mixed fabrics of cotton and worsted may be dyed by a more simple process than that commonly employed by passing the cloth through soap after the preparation of shumach or other such agent.

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627. *Method of Fixing Colours in connexion with the Printing of Woven Fabrics and Yarns.* R. C. Pattison, Dalderch House, near Catrine, Ayrshire; and A. M. Pattison, Glasgow. Dated March 14, 1861. Not proceeded with.

For the purpose of fixing certain colours derived from tar products upon yarn and woven fabrics, the inventors employ tannin, in combination with an alkaline earth, in the process of printing.

The improvements suggested in this and the preceding specification are very similar. It is probable that the prior employment of materials containing tannin has operated in these instances adversely to the claim of novelty.

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682. *Fixing Colouring Matters.* J. S. Miller and T. P. Miller, Springfield Works, Dalmarnock, North Britain. Dated March 18, 1861.

With the object of rendering more permanent such dyes as are procured from aniline and similar bases, the patentees entirely immerse the fabric in a solution of "the acetate of galls,"—*i.e.*, tannin of nut galls dissolved with the addition of acetic acid. The material is then withdrawn and dried. In this condition it is ready for printing upon with a thickened colour of the following nature:—The aniline dye or other colouring matter obtained from similar sources is added to a solution of "tartro-acetate of stannate of soda or potash" in quantity sufficient to produce the desired shade of colour on the goods to be printed or dyed, and the mixture thickened by the addition either of gum, starch, dextrin, or other suitable farinaceous substances, employed in such proportion as will communicate to the colouring matter the requisite degree of consistence for printing on the fabric; or, in the case of dyeing by immersion, this last ingredient is altogether omitted. As the best means of fixing the colour, the printed goods are finally submitted to the action of steam in the ordinary way. For the preparation of the tin mordant specified above, the stannate of soda or potash is neutralised with tartaric acid and then slightly acidulated with acetic acid; or, instead of this combination, citric acid may take the place of acetic, or any other double salt of an alkaline stannate, with the potash or soda salt of other acids, may be substituted for those already described.

It is interesting to remark the close analogy, or even identity, between this specification and one of earlier date, No. 612, which was not proceeded with. In both processes stannate of soda and tannin are employed in combination with a free acid and a thickening agent.

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693. *Producing Combinations of Certain Colours on Cotton Fabrics.* T. Brooks, Sunnyside, near Rawtenstall. Dated March 20, 1861.

For the simultaneous production of aniline and madder colours in dyeing cotton goods, the inventor applies at once the mordants for these colours respectively, thereby rendering the fabric capable of taking up the various tints, or any combination of them, in the subsequent process of dyeing.

701. *Dyeing and Printing Textile Materials and Fabrics.* N. Lloyd and J. G. Dale, Church, near Accrington. Dated March 20, 1861.

As an improved method of fixing upon cotton and linen fabrics the several colours of the aniline class, described under the names of mauve, Magenta, roseine, &c., the patentees mix with any one of these tannin, and a thickening agent, such as gum, senegal, or other suitable mucilaginous material. The goods are printed with the above, then submitted to the steaming process, and finally passed through a boiling solution of tartarised antimony.

According to the terms of this specification the materials employed are the same as those just now described in Nos. 612 and 682, with the substitution, however, of antimony for tin in the mordant.

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615. *Treating or Preparing Textile Materials and Fabrics.* A. Peek, Manchester. Dated March 13, 1861.

In this invention it is the object of the patentee to increase the density of substance, and to improve the finished appearance of cotton and other vegetable textile fabrics and materials. In operating upon yarns or fabrics the first operation is preparatory, and consists in the removal of all gummy and greasy impurities, by submitting them to the ordinary process of "bucking," or washing. After such preliminary cleansing they are passed through a solution of silicate of soda or potash, employed alone, or in combination with a fatty or resinous soap. The yarns or fabrics thus prepared are dried by artificial heat or otherwise, and then aged or exposed to the atmosphere for as long a time as possible. In order now to fix the silica in the materials they are submitted to the action of any soluble salt, by surface padding or otherwise, which is capable of decomposing the alkaline silicate, and also the soap, when such has been employed, and by being rendered insoluble in this manner is precipitated within the substance of, or becomes incorporated with, the fibrous materials, yarns, or fabrics.

The impregnation of cotton and other fabrics, with the silicates of the alkalies and other compounds derived from the same, has frequently been practised for the purpose of rendering such materials less sensitive to the action of fire. These efforts have, however, been generally abandoned on account of the harshness and impoverished appearance of the fabric so treated, and with the exception of the method of preparation with soap and alum, applied to woollen material, no advantage beyond the single consideration to the manufacturer of rendering the goods more weighty seems likely to result from the mode of treatment here proposed.

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619. *Silvering Glass, &c.* J. Cimeg, Great Portland Street, London. Dated March 13, 1861.

For the purpose of depositing a bright film of metallic silver upon glass and other services, the inventor employs ammonio-nitrate of silver, to which he adds a solution of Rochelle salt (tartrate of potash and soda). The silver is deposited by the action of this reducing agent at the ordinary temperature of the air, no external aid being required for the purpose of facilitating the production of the metallic film. The thin layer of silver so formed may be backed and strengthened by an electro-deposit of copper, or other cheap metal. This method of operating is also useful for the coating of small objects prior to electrotyping, which, being non-conductors of electricity, require to have a superficial conducting layer imparted to them. By commencing with a plate of glass having polished and dull surfaces, an ornamental device may be executed.

This process of depositing bright metallic silver upon glass was experimentally illustrated by Professor Faraday at one of his Friday evening lectures at the Royal Institution some years since. The brilliant lustre of the truly "silvered" surfaces was much admired.

Grants of Provisional Protection for Six Months.

2164. Hippolyte Lecaudey, Wellington Street, Strand, London, "Improved apparatus for succouring persons interred before life is extinct."—A communication from Raymond Malerille, Bordeaux, France.—Petition recorded August 30, 1861.

2323. George White, Pancras Lane, London, "Improvements in apparatus for filtering or purifying water or other liquids." A communication from Mr. Jean Antoine Victor Burq, Paris.—Petition recorded September 18, 1861.

2382. Thomas Davey, Tucking Mill, Camborne, Cornwall, "Improvements in the manufacture of safety fuses, parts of which are applicable to the manufacture of pipes and tubes of lead, and other soft metal, gutta-percha, caoutchouc, bitumen, and earthenware."—Petition recorded September 24, 1861.

2460. Edgar Breffit, King William Street, London, "Improvements in machinery employed in cutting hollow and solid corks."—Petitions recorded October 2, 1861.

2469. Robert John Ellershaw, Leeds, Yorkshire, "An improved machine for expressing oil."—Petition recorded October 3, 1861.

2482. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment or preparation of certain foreign plants or vegetable substances, and of the application of the same to various useful purposes, for which horn, shell, whalebone, indurated leather, fish skin, ivory, bone, hard wood, and compounds of india-rubber or gutta-percha, have hitherto been employed."—Petition recorded October 4, 1861.

2515. Isham Baggs, Green Terrace, and James Thomas Parkes, Almorah Terrace, Middlesex. "Certain improvements in the manufacture and treatment of india-rubber and vulcanite as applied to various purposes."—Petitions recorded October 9, 1861.

2586. Charles de Groote, Brussels, Belgium, "An improved instrument for corking bottles and other vessels."

2597. Charles Denton Abel, Southampton Buildings, Chancery Lane, London, "Improvements in apparatus for the simultaneous manufacture of white lead and vinegar."—A communication from Robert Rowland, New York, U.S.

2607. James Webster, Birmingham, "Improvements in manufacturing oxygen gas and obtaining certain other products."

2699. Robert Mushet, Coleford, Gloucestershire, "A new or improved manufacture of titanic pig metal or alloy of titanium and iron."

2618. Frederick John Evans, Gasworks, Horseferry Road, Westminster, "An improved mode of, and apparatus for, carburetting gases for the purpose of illumination."

2620. Henry Lamplough, Holborn Hill, London, "Improvements in the means for igniting the wicks of candles and lampwicks."

2623. Josiah Timmis Smith, Barrow-in-Furness, Lancashire, "An improvement or improvements in collecting the inflammable gases evolved from blast furnaces."

2635. Herbert Frost, Manchester, "Improvements in apparatus for measuring fluids."

2637. Robert Mushet, Coleford, Gloucestershire, "An improvement or improvements in the manufacture of a certain metallic alloy."

2641. Richard Archibald Brooman, Fleet Street, London, "Improvements in reaping machines." A communication from Cyrus Hall McCormick.

Inventions Protected for Six Months by the Deposit of Complete Specifications.

2669. Enoch Chambers, Melbourne, Victoria, "The use of hydraulic power for the breaking, crushing, or pulverising of quartz, blue stone, or other stone or mineral of any description, and the use of a wrought iron lever or jaw in machines for crushing quartz or other mineral, and the use of steel teeth and steel shield pieces for the levers or jaws in such machines."—Deposited and recorded October 25, 1861.

2683. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "Improved apparatus for ascertaining the presence and degree or cessation of vitality in the human body and in animals of the higher class, applicable to the semeiosis of health, disease, and death."—A communication from Léon Victor Collongues, Grande Rue Passy Lez, Paris, France.—Deposited and recorded October 26, 1861.

Notices to Proceed.

1611. James Smith McArdle, Galway Ireland, "Improvements in treatment of sea-weeds for the purpose of obtaining therefrom certain valuable products."—Petitions recorded June 22, 1861.

1619. Jules Lafon, Bordeaux, Gironde, France, "Improvements in the production of chromo-lithographic impressions upon glass, porcelain, and other similar material."

1622. James Brown, Newport, Monmouthshire, "An improvement in the manufacture of iron."—Petitions recorded June 25, 1861.

1666. William Clark, Chancery Lane, London, "Improvements in the distillation of solid and liquid combustible matters."—A communication from M. Etienne Charles Zacharie Bouchard, Boulevart St. Martin, Paris.

1671. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in apparatus for manufacturing and bottling aërated liquids."—A communication from Messieurs Auguste Mondollot and Jean Alphonse Mondollot, Paris.

1741. Charles Cochrane, Ormesby Ironworks, Middlesborough-on-Tees, Yorkshire, "Improvements in treating gas in its passage from blast furnaces to the furnaces, stoves, boilers, or other heating apparatus where the gas is employed."

1783. Emile Georges Fermier de la Provotais, Boulevart St. Martin, Paris, "Extracting the fibres from genista scoparia (broom), and their application to manufacturing paper and fabrics, and also treating the washing waters so as to obtain dyeing products therefrom."—Petition recorded July 15, 1861.

1905. Alfred Wood, Lewes, Sussex, "Improvements in refrigerating storehouses, and in other structures in which a low temperature is continually or periodically required."—Petitions recorded July 31, 1861.

2339. Edgar Breffit, King William Street, London, "An improved fuel."—Petition recorded September 19, 1861.

2460. Edgar Breffit, King William Street, London, "Improvements in machinery employed in cutting hollow and solid corks."

2669. Enoch Chambers, Melbourne, Victoria, "The use of hydraulic power for the breaking, crushing, or pulverising of quartz, blue stone, or other stone or mineral of any description, and the use of a wrought iron lever or jaw in machines for crushing quartz or any other mineral, and the use of steel teeth and steel shield-pieces for the levers or jaws in such machines."—Petition recorded October 25, 1861.

CORRESPONDENCE.

Economising the Waste Fumes from Vitriol Chambers.

To the Editor of the Chemical News.

Sir,—In last week's Number there is a short account of a patent (514) for economising the waste fumes from vitriol chambers. A similar idea occurred to me three years ago. I found that although sulphuric acid does not dissolve metallic copper alone, it will do so if nitrous fumes are passed through it; I have made sulphate of copper in this way. The reason why the process was not largely carried out was, that the dilute acid only dissolves very little nitrous gas; strong acid dissolves large quantities;

but if the copper be placed in strong acid, and red fumes passed through the mixture, sulphate is formed, but in very small white-looking crystals, which are difficult to free from excess of acid economically.

The idea occurred to me then to treat pyrites containing both copper and iron, after burning, with vitriol and red fumes, and so to obtain a solution of sulphate of iron and of copper, by distilling gas liquor so as to pass the crude ammonia into the mixture; sulphate of ammonia and ammonio sulphate of copper remain, and the peroxide of iron precipitated may be re-dissolved in waste spirits of salts, to form a cheap persalt of iron for black, &c. dyeing. The mixed solutions I proposed to mix with copper scales (oxide) and evaporate to dryness, and heat in a retort to recover the ammonia, and leave pure sulphate of copper anhydrous. But the last operation has always failed from various causes already detailed; although ammonia is at first evolved, and sulphate of copper formed, afterwards other reactions take place. Although the idea of thus economising waste nitrous fumes failed with me, I am not aware that anyone has a priority on the score of originality. I may also add that I proposed an arrangement for the operation, which was perfect in its action. I arranged a series of Woulfe's receivers; in the first was a saturated solution of nitrous gas in strong vitriol, on adding water to which gradually the gas was evolved, and passed through the second; the gas, now reduced to nitric acid, was passed through the third, fourth, &c., with the addition of sufficient air to reconvert it into red nitrous gas. In the last receiver, strong vitriol absorbed the gas for another operation, by reversing the arrangement. Of course the receivers between the two extremes were charged with dilute acid and copper.—I am, &c.

John S. Blockey.

Sheepscar Chemical Works, Leeds, Nov. 14.

MISCELLANEOUS.

SCIENTIFIC NOMENCLATURE.

In reply to C. W. M., whose letter on this subject we reprinted from the *Athenæum* in our 101st Number, C. M. Q. writes as follows to the same paper:—

Although agreeing in the main with the remarks of your correspondent "C. W. M." on scientific nomenclature, I must take exception to that part of his letter in which he attacks the chemical philosophers. He sets out with the dictum, "Science is not for the idler." He must forgive me if I add a rider to it,—"Chemical nomenclature is not for the superficial." It is singular that he should find such fault with the only science amongst those which he aptly terms sciences of observation which possesses a perfectly intelligible and logical nomenclature. Chemical nomenclature, as founded by the immortal Lavoisier, is governed by a fixed principle, which ordains that every name shall express the composition of the substance for which it stands. An adept in chemical science knows at once the exact chemical composition of any body from the formation and termination of the name given to it. The word "methylethylamylophenylammonium," which appears so unintelligible to "C. W. M.," is as easily remembered and understood by a chemist as "light blue, ruled, foolscap paper" would be by an ordinary individual. In this, chemical nomenclature stands in favourable contrast to that adopted by botanists. Such cacophonous epithets as "*Bogglesia Wigginsii*" simply afford the information that the plant so designated was discovered by the illustrious but mythical personages Boggles and Wiggins, without giving the smallest clue to its properties or character; but the term "Bichloride of rubidethyl," although just as imaginary, is the name of a substance, of certain composition, which may or may not be discovered some day. As to the synonymes possessed by a very few chemical substances, it is the manufacturers and workmen who are the perpetrators of errors. Mere vendors cannot be posted up in the known composition of their wares. They are asked for spirits of salt, and they sell it. Ask them for hydrochloric acid, and they stare at you. As chemical science advances, names must necessarily change; but if "C. W. M." will examine the standard chemical works of the last twenty or thirty years, he will find but few alterations. The principal changes in this way are additions and not substitutions. When a new element or radical is discovered, a name is given to it descriptive either of its source or of some salient property. For instance, Bunsen has lately discovered two new metals, cæsium and rubidium, by means of spectral analysis. Their names have been given to them from their forming blueish *(cæsius)* and ruby lines in the spectrum. "C. W. M." is mistaken in saying that *organic* chemists call sulphates thionates. Sulphur compounds of the thionic series are *inorganic* substances, and are quite distinct in their composition from sulphates. Chlorhydric acid is simply the French form of hydrochloric acid; the difference in the two words being euphonic, and not theoretical, as in the long-abandoned name—muriatic acid. As to "hydrachlora," I fear it is only the invention of an enthusiast with a theory and nomenclature of his own. The proposed substitution for the ammonium compound must, I fancy, come into the same category; but, not having seen the article mentioned by "C. W. M.," it would be wrong to speak positively, "C. W. M." deserves the thanks of all scientific men for having stirred up the subject; and I trust it will be the means of calling forth many more remarks from abler pens than mine.

In conclusion, I beg to assure "C. W. M." that I make these explanations with perfect good humour, and only hope that he will be induced thereby to study chemical nomenclature a little more closely. He will soon see the beauty and intelligibility of such apparently absurd words as "ethylomethylopropylamine," and a host of others.

THE LIME LIGHT AT THE SOUTH FORELAND.

Five-and-thirty years ago Lieut. Drummond brought into notice the oxyhydrogen light, and applied it to a practical purpose. Having been appointed to conduct the Ordnance survey in Scotland and Ireland, he used this light in the focus of a parabolic reflector on lofty eminences, where the stations were usually placed, as it was of the greatest importance in those operations to have certain and determinate signals, which could be seen, under any circumstances as to weather, at great distances. Thus he succeeded in connecting the shores of England and Ireland, near Holyhead, a distance of 65 miles, and afterwards, in Scotland, the summit of Ben Lomond with that of Knock Layd, no less than 95 miles apart. It did not escape the comprehensive mind of Drummond to perceive that such a light, if capable of practical application, would be invaluable for lighthouse purposes. With the means he devised, however, he failed to obtain anything approaching practical command over the continuity of the light; and as a light that is liable to go out is inadmissible for lighthouse purposes, it is not surprising that it was condemned.

Since Drummond's time, until quite recently, the oxyhydrogen, or lime light, has been used only for the purposes of the microscope, or to produce scenic effects; not that the value of a light of such power and intensity has been lost sight of, but because all attempts to render it practically available in a commercial sense had failed.

The impossibility of turning it to a useful purpose seems to have so taken possession of the public mind, scientific as well as general, that although within the last two or three years, exhibition after exhibition, varying in duration from hours to months, have given the most incontestable proofs that with Bartable's apparatus the lime light can be burned as easily and certainly as a wax candle, yet, with a single but notable exception, not one eminent man of science has been found who has not scouted the idea of its practical utility. Upon almost every occasion of late when our men of science have condescended to mention the lime light, it has been condemned by them as impracticable, and the idea of its applicability to any useful purposes contemptuously dismissed; whilst the assumption that it can be used for ordinary domestic purposes has met with most positive contradiction, interspersed, upon one or two occasions, with assertions as to the available sources and expense of oxygen gas, which, although valueless in themselves, are useful as indicating the amount and accuracy of information upon the subject possessed by some of those who have pronounced the severest condemnations of it. It has been the fashion in scientific circles to condemn the lime light, and there are few amongst those who have not compromised themselves more or less by decrying it; and experience will have taught us that from such we can expect but a tardy recognition of even a fact that is subversive of a long cherished dogma. This prejudice, which has seriously impeded the general introduction of the lime light, is traceable to its usual source—want of accurate information on the subject; for although the means were at hand, not one of those who ridiculed the idea that the lime light had been brought to a state of perfection, rendering its practical application to illuminating purposes easy and certain, took any trouble to make such an investigation as to the alleged fact as could justify the expression of any opinion at all. The public at large took the view of the *savans*, whose opinions were readily adopted and disseminated by those who are interested in the continuance of the present methods of producing artificial light; whilst the verdict of gas engineers, scientific advisers to Gas Companies, and other vested interests, upon the lime light was such as a notorious poacher might expect at the hands of a jury composed of cock-pheasants.

In the mean time, however, whilst the learned condemn it, and capital fought shy of it, the light went on burning steadily—carefully watched, examined, and, in course of time, appreciated by one, at whose hands truth never suffers, imposture is never spared, and whose opinions are ever formed for himself by patient and careful investigation, and not expressed until all doubt has been removed. Without having been made aware of the exact conclusions arrived at by this investigation, it must be supposed to have been favourable, as it led to a decision on the part of the Trinity Board to give the light a fair trial in a first order lighthouse, for which its peculiar qualities are pre-eminently fitted. To this end a contract was entered into with the Universal Lime Light Company by the Elder Brethren for the exhibition of the light in the South Foreland Lighthouse for three months, and upon its success will, in all probability, depend its extensive adoption for the purposes of coast lighting. The light was introduced on the 26th of August, and has continued to burn steadily and brilliantly every night since its substitution for the oil light. Indeed, after the report of Mr. Page, the engineer of Westminster bridge, upon the success of the lime light which for two months illuminated the finished part of that structure, no doubt can exist as to the facility with which it can be maintained, for no case of failure occurred there in maintaining regularly eighteen lights in nine different lamps, where the operation of making the gases had to be conducted upon temporary platforms, suspended between wind and water, and the whole arrangements necessarily of an incomplete and temporary character, added very largely to the ordinary risk of a failure occurring. The lamp at the South Foreland is fitted with eight burners, to meet the requirements of the Fresnel apparatus, which is composed of eight panels: only six out of the eight burners, however, are required, as the two panels towards the land are darkened. The manipulation of the lamp is perfectly simple, not necessitating an amount of intelligence greater than is required in the case of an ordinary Argand lamp. When the time for lighting comes the lime wicks are inserted, the clock which moves them wound up, and the gases turned on, and no further attention is required until the hour arrives for putting out the light, when the gases are turned off, and the clock is stopped; the lime wicks are then removed, and nothing further remains to be done. The brilliancy of the light has not escaped the notice of our friends on the other side of the Channel, many of whom have been over to visit it. It is but fair to state that the present apparatus in which the lamp is exhibited is not calculated to give the maximum effect, having been especially adjusted for the usual Argand oil lamp, which differs from the lime light in the essential particular of focal distance, which is measured from the centre of the former, but from the surface of the latter; the lime light, therefore, although of the same diameter as the oil flame, is too near the lenses by half its diameter—in this case by $1\frac{7}{8}$ inches. It is to be hoped that this light will be tried both in a French apparatus, specially adjusted, and in the focus of a paraboloid, for it appears to possess every element, rendering it by far the best light for coast purposes ever introduced.

Amongst other attributes of the lime light is another of the very last importance. It is not affected by wind, even though unprotected by glass. At Liverpool, where the lime light was exhibited for two months upon the landing stage where the Birkenhead ferry boats ply, this property was most severely tested. One night a gale of wind came on, and increased in violence until the glasses of the lanterns were dashed in, and the light was exposed to its full power. No apparent effect was produced upon them, for they continued to burn as steadily and brightly as before. It has happened not so unfrequently as might be imagined, that the glass of our lighthouses has been broken, in violent gales, and the light blown out.

Professorship of Chemistry at Cambridge University.—This Professorship having become vacant by the death of the Rev. James Cumming, the election of a new Professor will take place on Friday, the 6th day of December next. The electors to the Professorship are the persons whose names are on the electoral roll of the University. The Vice-Chancellor and the proctors will receive the votes of the electors from eleven o'clock in the morning till one o'clock, when the Vice-Chancellor will declare the election.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

H. A. Simcol.—The minimum thermometer can be procured at Mr. Casella's, Hatton Garden, London.

A would-be Member.—Write to the Secretary, Burlington House, Piccadilly, who will forward you the necessary information and blank forms to be filled up.

E. Ballard.—Received with thanks. In our next.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Suggestions for a New System of Chemical Nomenclature, with reference more particularly to Organic Substances, by JOHN A. R. NEWLANDS, *F.C.S.*

CERTAIN letters, or syllables, are employed to denote the various quantities of each constituent in the substance named, and by uniting these the names are produced.

The accompanying list of numerals, which may be learned without much difficulty, is adapted for this purpose, though it, no doubt, admits of great improvement. Names constructed on these principles can be converted into formulæ, and formulæ into names, with the greatest ease, the one being an exact counterpart or reflex of the other. The names thus created may be either used *per se* or in conjunction with those at present existing. Thus, caprylic acid, $C_8H_{16}O_2$, may be either called meddatic acid, or medda-caprylic acid; and milk-sugar, $C_{12}H_{24}O_{12}$, may be named sepsatone, or sepsatic sugar, or sepsa sugar.

The numerals chosen for carbon are the consonants, simple and compound; thus, *b* signifies one of carbon; *d*, two of carbon; *f*, three; *g*, four; and so on in alphabetical order. The letter *c* is not employed, as its sound is always identical either with that of *k* or of *s*. *Q* and *x* are omitted for equally good reasons.

The numerals for hydrogen consist of a vowel followed by a consonant: thus, *ab* signifies one of hydrogen; *ad*, two; *af*, three; *ag*, four, &c.

Those for oxygen are simply the reverse of the preceding: thus, *ba* signifies one of oxygen; *da*, two; *fa*, three; *ga*, four, &c.

Lastly, the name is completed by a termination indicating its chemical properties: thus, acids may be made to end in *-ic;* bases, in *-ine;* neutral bodies, in *-one;* and hydrocarbons, in *-yl*.

The name of the group to which a substance belongs may also be frequently appended with advantage, such as *sugar*, *alcohol*, *aldehyde*, &c.

When two vowels come together, the letter *t* may be inserted to preserve euphony.

The following examples may serve to illustrate the method of nomenclature:—

1. Give the name of starch, $C_{12}H_{20}O_{10}$. Now, C_{12} is *s*; H_{20}, *ek*; and O_{10}, *pa*; the name is, therefore, *sekpa-tone*, or sekpatic starch.

2. Name, phenyl, C_6H_5. C_6 is *k*; and H_5, *ah*; the name is, therefore, *kahyl*, the base, phenylamine, $N(C_6H_5H_2)$, being called *kahylamine*.

3. Name, ethylic-alcohol, C_2H_6O. C_2 is *d*; H_6, *ak*; and O, *ba*. The name thus formed is *dakba*, or dakbatic-alcohol.

4. Give the formula of *mahban-one*. Here, *m* is C_8; *ah*, H_5; *ba*, O; and *n*, N. The formula, therefore, is, C_8H_5NO, or blue indigo.

5. What is the formula of *lakdatic acid?* *l* is C_7; *ak*, H_6; and *da*, O_2. The formula, then, is, $C_7H_6O_2$, or benzoic acid.

6. Give the formula of *zehfan-ine*. *z* is C_{17}; *eh*, H_{19}; *fa*, O_3; and N, *n*; giving the formula, $C_{17}H_{19}NO_3$, or morphine.

Isomeric substances are distinguished by making a difference in their termination, thus:—

Allylic glycerin, $C_3H_6O_3$''' *fakfatic* glycerin, or *fakfaterin*.
Lactic acid, $C_3H_6O_3$ *fakfatic* acid.

The amount of nitrogen in a substance is indicated by the letter *n*, with or without a vowel, placed immediately before the end of the name: thus. *n* is N; *na*, N_2; *ne*, N_3; *ni*, N_4, &c.

In like manner phosphorus may be represented by *p*, *pa*, *pe*, *pi*, &c.; arsenic by *r*, *ra*, *re*, *ri*, &c.; sulphur, by *s*, *sa*, *se*, *si*, &c. The same plan may be extended to other elements.

If one of these syllables be followed by a vowel, the letter *m* is inserted instead of *t*, in order to distinguish between substances containing N and those containing NO_2.

Nomenclature of Substitution Products.

These may be named as at present, thus benzoic, nitrobenzoic, and binitrobenzoic acids may be termed *lakdatic*, *nitrolakdatic*, and *binitrolakdatic* acids, respectively; or a syllable may be introduced expressing the number of equivalents of hyponitric acid, chlorine, bromine, iodine, &c., which have replaced hydrogen in the normal substance: thus,—

Benzoic acid,	$C_7H_6O_2$,	*lakdatic* acid
Nitrobenzoic acid,	$C_7(H_5NO_2)O_2$,	*lakdanatic* acid
Binitrobenzoic acid,	$C_7(H_4{}_2NO_2)O_2$,	*lakdanetic* acid

Different quantities of NO_2 being represented by the syllables, *nat*, *net*, *nit*, *not*, and *nut*; of chlorine, by *cat*, *cet*, &c.; of bromine, by *bat*, *bet*, *bit*, &c.; and of iodine, by *dat*, *det*, *dit*, &c. Thus, in the case of acetic acid we have,—

Acetic acid,	$C_2H_4O_2$	= *dagdatic* acid
Monochloracetic acid,	$C_2(H_3Cl)O_2$,	= *dagdacatic* acid
Trichloracetic acid,	$C_2(HCl_3)O_2$,	= *dagdacitic* acid
Monobromacetic acid,	$C_2(H_3Br)O_2$,	= *dagdabatic* acid
Dibromacetic acid,	$C_2(H_2Br_2)O_2$,	= *dagdabetic* acid
Iodacetic acid,	$C_2(H_3I)O_2$,	= *dagdadatic* acid
Diiodacetic acid,	$C_2(H_2I_2)O_2$,	= *dagdadetic* acid

As every change in composition is accompanied by a corresponding change in name, all the various modes of arranging bodies, such as homologous and isologous series, different degrees of oxidation, &c., have characteristic terms allotted to them.

Names deduced from empirical or rational formulæ may be distinguished as empirical or rational names. Thus, the rational name for aniline, $N(C_6H_5H_2)$, is, as we have already seen, *kahylamine;* the empirical name, deduced from the formula C_6H_7N, is *kalnine*. Those of similar bodies, containing phosphorus or arsenic, in the place of nitrogen, would be,—

C_6H_7P, *kalpine*, and
C_6H_7As, *kalrine*.

List of Numerals.

This list furnishes the names of organic compounds up to those containing 34 equivalents of C and 68 of H or O.

The numerals for O are merely the reverse of those for H; it is, therefore, only necessary to learn the latter.

	C.	H.		C.	H.		H.		H.
1	*b*	*ab*	18	*bl*	*eg*	35	*il*	52	*op*
2	*d*	*ad*	19	*br*	*eh*	36	*im*	53	*or*
3	*f*	*af*	20	*ch*	*ek*	37	*in*	54	*os*
4	*g*	*ag*	21	*cl*	*el*	38	*ip*	55	*ot*
5	*h*	*ah*	22	*cr*	*em*	39	*ir*	56	*ov*
6	*k*	*ak*	23	*dr*	*en*	40	*is*	57	*ub*
7	*l*	*al*	24	*fl*	*ep*	41	*it*	58	*ud*
8	*m*	*am*	25	*fr*	*er*	42	*iv*	59	*uf*
9	*n*	*an*	26	*gl*	*es*	43	*ob*	60	*ug*
10	*p*	*ap*	27	*gr*	*el*	44	*od*	61	*uh*
11	*r*	*ar*	28	*pl*	*ev*	45	*of*	62	*uk*
12	*s*	*as*	29	*pr*	*ib*	46	*og*	63	*ul*
13	*t*	*at*	30	*sl*	*id*	47	*oh*	64	*um*
14	*v*	*av*	31	*sp*	*if*	48	*ok*	65	*un*
15	*w*	*eb*	32	*st*	*ig*	49	*ol*	66	*up*
16	*y*	*ed*	33	*spl*	*ih*	50	*om*	67	*ur*
17	*z*	*ef*	34	*str*	*ik*	51	*on*	68	*us*

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page 272.*)

Determination of the Proportional Relation between Silver and Chloride of Sodium.—I have made ten determinations of the proportional relation between silver and chloride of sodium. To effect this I made use of chloride of sodium prepared by six different processes. I will describe each of them briefly.

I. Chloride of Sodium from Carbonate of Soda.—Commercial bicarbonate of soda was heated to dull redness in a silver dish, to render insoluble the iron which this body always contains. The residue, after cooling, was dissolved in pure cold water, and the solution evaporated to a pellicle in a platinum dish, and then allowed to crystallise. This was repeated ten successive times.

The carbonate was transformed into chloride in the same platinum vessel by passing a current of pure hydrochloric acid through the solution. The resulting salt was dried, heated to dull redness, and then taken up with cold water. The solution was decanted after standing twenty-four hours to separate the silica which was deposited, and then evaporated again. The chloride of sodium, which was perfectly white, was mixed with a tenth of its weight of pure chloride of ammonium containing chloroplatinate of ammonia, and then treated as I have explained above in the case of chloride of potassium obtained from nitrate of potash.

Chloride of sodium thus prepared is perfectly colourless and slightly hygrometric, a property which is not possessed by chloride of potassium. Its specific gravity differs according to whether it has been slowly or rapidly cooled after fusion. I have found it comprise between 2·125 and 2·150. When dissolved in cold water it produces a neutral and perfectly limpid solution.

Nos. I. and II. show the results furnished by two specimens of chloride produced from two distinct samples of carbonate. The silver used in No. II. was prepared by M. Liebig.

II.—Chloride of Sodium from Colourless Rock Salt.—Some perfectly colourless rock salt free from iron, manganese, and sulphate, but still containing traces of magnesium and calcium, was submitted in a platinum dish to six crystallisations from a hot solution. As it was possible that the boiling mother liquid might contain potassium, this was always thrown away. The perfectly white salt was pulverised and exhausted with alcohol at 96 per cent., and then digested with alcohol at 65, containing bichloride of platinum. The clear alcoholic solution was separated and replaced by a fresh quantity of alcohol at 70, still containing bichloride of platinum, until about one-third of the salt was dissolved. These solutions were mixed together.

The residuary saline mass was treated with a fresh quantity of alcohol at 70, containing bichloride of platinum, until about one-third of the salt employed was left undissolved. The solutions obtained by this second treatment were then mixed together. The first and the second solution each represent, therefore, a third of the total weight of the salt experimented upon. The two solutions were separately precipitated by absolutely pure sal-ammoniac. After standing sufficiently long, they were decanted and evaporated to dryness in a platinum retort. The salt was mixed with pure sal-ammoniac and chloroplatinate of ammonia, and treated as I have explained in the case of chloride of potassium from nitre.

No. III. shows the result furnished by some of the first third of the salt, and Nos. IV. and V. the results obtained by some of the second third. The extraordinary concordance of these results proves the identity of the two chlorides, and demonstrates also to what accuracy it is possible to arrive by the wet way.

III.—Chloride of Sodium from Sulphate of Soda.—Sulphate of soda freed from all foreign metals by the ebullition of its solution with a slight excess of sulphide of sodium and carbonate of soda, was submitted to ten successive crystallisations. The salt thus obtained was dried in a platinum dish and mixed with twice its weight of chloride of ammonium prepared by the direct action of ammonia and pure hydrochloric acid. The mixture was heated to dull redness. The residue, mixed again with its own weight of pure sal-ammoniac, was heated to redness a second time. All the sulphate is thus converted into marine salt contaminated with traces of platinum and silica. It was fused with a small quantity of pure sal-ammoniac and chloroplatinate of ammonia, and treated as previously explained in the case of chloride of potassium from nitre.

No. VI. shows the result furnished by this salt.

IV. Chloride of Sodium from Tartrate of Soda.—Pure carbonate of soda was neutralised by tartaric acid prepared by decomposing tartrate of lead with hydrosulphuric acid.

The tartrate, crystallised a great many times, was dried and boiled several successive times with alcohol at 96, and then transformed into chloride by the means which I employed in the preparation of chloride of potassium from pure cream of tartar.

The result obtained is shown at No. VII.

V. Chloride of Sodium from Nitrate of Soda.—With this object I have prepared pure nitrate of soda from Chili saltpetre, from which I have eliminated the foreign metals by a mixture of sulphide of sodium and carbonate of soda, and which I have then crystallised at least ten successive times from pure water. This nitrate

was converted into pure chloride by the means employed to convert saltpetre into chloride of potassium.

No. VIII. shows the result obtained by this chloride.

VII. Chloride of Sodium from Chloro-platinate of Soda.—The chloride of sodium from rock salt, purified with bichloride of platinum and alcohol, and of which the results are given in Nos. III., IV., and V., was mixed with three times its weight of bichloride of platinum. The mixture was dissolved in pure water, and the solution evaporated to dryness. The residue taken up by a small quantity of water, at once completely dissolved in it. This solution, evaporated to a pellicle, was allowed to crystallise; the mother liquor was decanted. The crystals of a pure golden yellow colour were taken up by the smallest possible quantity of boiling water, and furnished, upon cooling, a fresh crystallisation of chloroplatinate of soda. I have in this manner effected the solution and crystallisation of chloroplatinate of soda six successive times. At this point I removed a certain quantity, and continued the solutions and crystallisations six times more.

The two chloroplatinates thus prepared were of a pure golden yellow. After having dissolved them in water, I decomposed them separately with pure chloride of ammonium, and evaporated the solution to dryness in a platinum dish. The resulting chlorides were then treated as I have above explained in the case of chloride of potassium from nitre.

In submitting the chloroplatinate of soda to so great a number of crystallisations, my object was to concentrate in the mother liquors the chloroplatinates more soluble than that of soda, and in the chloroplatinate of sodium the chloroplatinates less soluble than this; chloroplatinate of potassium, for instance, if by any means the salt employed in the preparation of the double salt could contain traces of a potassium compound.

I commenced the operation with about three hundred grammes of chloroplatinate of soda, and at the end of the operation I had separated above two-thirds of the compound with the mother liquors.

No. IX. shows the result obtained by means of the salt prepared from the chloroplatinate, which was crystallised six times; and No. X. that of the salt crystallised twelve times. The almost absolute identity of the two results prove in the clearest manner that the salt employed contains no chloride capable of producing a chloroplatinate less soluble than that of soda. This identity proves, moreover, that the double salt contains no chloride having a higher equivalent than that of chloride of sodium itself.

All the specimens, indiscriminately, of chloride of sodium experimented upon were colourless, and dissolved in water, producing a neutral and absolutely limpid liquid. I happened to preserve for a month in a stoppered glass vessel a solution of this compound, without perceiving the slightest trace of any deposit. I am, therefore, thoroughly convinced that it is impossible by the means at present at our disposal to prepare this chloride in a state of greater purity.

As the purest marine salt is slightly hygrometric, when I weighed it, I always heated it nearly to redness in a closed platinum crucible, and immediately introduced it into a tube closed at one end and furnished with a glass stopper ground in and pierced with a small hole. During cooling, this tube was placed under a bell-jar with sulphuric acid.

Proportional Relation between Silver and Chloride of Sodium.

Numerical Order.	Weight of the Chloride of Sodium in air.	Weight of the Chloride of Sodium reduced to a vacuum.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the excess of Silver after the double decomposition.	Weight of the Chloride of Sodium corresponding to the excess of Silver.	100·000 parts of Silver are equivalent to
	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.	
I.	4·87865	4·88128	9·01103	9·01159	0·0071	0·00384	54·2093
II.	5·32495	5·32781	9·83535	9·83595	0·0076	0·00412	54·2088
III.	4·40145	4·40382	8·12960	8·13012	0·0062	0·00336	54·2070
IV.	4·07495	4·07715	7·5266	7·52704	0·0056	0·00350	54·2070
V.	10·5754	10·5808	19·5326	19·5338	0·0146	0·00791	54·2070
VI.	6·7913	6·79496	12·5438	12·5446	0·0091	0·00493	54·2060
VII.	10·5192	10·5249	19·4293	19·4305	0·0145	0·00790	54·2076
VIII.	13·8862	13·8937	25·6483	25·6499	0·0194	0·01074	54·2081
IX.	18·1874	18·1972	33·59275	33·59483	0·0257	0·01393	54·2083
X.	6·3462	6·3496	11·7216	11·72263	0·0091	0·00493	54·2089
						Mean	54·2078

Parts of Chloride of Sodium.

(To be continued.)

On the Adulteration of Butter with Animal Fats, by EDWARD BALLARD, *M.D. Lond., M.R.C.P., Medical Officer of Health for Islington, and Parochial Analyst under the Adulteration of Food Act.*

As the ether test for foreign fats in butter, described by Mr. Horsley in a recent Number of the CHEMICAL NEWS, is somewhat an expensive one, and, on this account the less likely to come into much practical use, I am induced to send for your readers a description of some other tests cheaper and more readily applied,

The most frequent adulterating fat by far is that of beef. We may call it beef "dripping" if we will, dripping being the form in which the fat I refer to is best known. That such is the case may be seen by any one who will collect at 65° the residue of solution by ether and melt it in a watch-glass. It will, on cooling, be seen to possess the physical characters of beef dripping, with the exception of the odour and taste, both of which are wanting. These characters are, a dull, yellowish colour, granular texture, but less so than mutton dripping, melting slowly on the tongue, with a granular feel when the tongue is moved upon it. Its consistence is firm, and when the mass is broken by a spatula the granulations do not separate like those of mutton, and its consistence is more waxy. Mutton dripping is white.

The simple distinguishing character between pure butter and butter adulterated with beef dripping may

be noticed in the following particulars:—Its colour, consistence, odour, the appearance on washing with hot water, the occurrences on drying on blotting-paper, the physical characters when dried, and the results on pressure of the dried mass. To render these observations more precise in statement, I will give them in parallel columns, the adulteration of the butter for this purpose being supposed to be in equal proportions of butter and beef dripping.

Butter, newly churned and free from Salt.	**Butter Adulterated with Dripping.**
Colour.—Bright yellow—uniform.	Paler (paleness increases with the proportion of dripping)—often marbled yellow and white.
Consistence.—Firm at 54°.	Firmer (increasing with proportion of dripping).
Odour.—Strongly butyraceous.	Butyraceous odour lessened (but still present even in large amounts of adulteration).
Appearance on washing, in a glass half-a-pint beaker, one oz. with boiling water.—A melted layer occurs on the surface, consisting, as viewed at the side of the beaker, of minute drops, which, lying closely together, give a finely cellular aspect to the layer. When cool the cake is a soft solid, fluctuating on agitation of the glass, or, at any rate, yielding readily when the glass is tilted. The water below is very opaque with milkiness. The cake is yellow.	The melted layer consists of much larger drops, and the cellular appearance, therefore larger. On cooling, the cake is firmer, paler in colour, sometimes marbled, does not yield at all or much less readily to tilting of the beaker. The water below is less opaque with milkiness, (and often deposits dirt from the salt used in preparation).
On Transference to Blotting-paper. — The mass is wet, and the wet runs away slowly.	The mass is almost dry on removal from water, and the remaining water rapidly runs away into the paper.
The blotting-paper acquires a marked yellow, greasy stain, which runs extensively over it. On transferring the butter to a second fold of paper, this stain is again imparted.	The stain to first blotting-paper is less marked, and that to second also. Both are of a less deep tint.
Physical Characters of Dried Butter. — Colour, bright yellow—odour, butyraceous—breaks under pressure of the spatula at 54° into fine mealiness—taste, butyraceous, not melting on tongue so smoothly as unwashed butter, but still quickly, and with little sense of granulation.	Colour less yellow—odour, that of dripping, but more or less butyraceous (this varying with the relative proportions of the two)—has a coarsely granular appearance in mass, and on gentle pressure with a spatula at 54° breaks down into independent granules very readily, these being the size of fine pearl sago and globular in shape—taste of the dripping distinctly perceptible (in low degrees of adulteration this is less marked)
Pressure of a little heap the size of a pea firmly and quickly by a spatula between a fold of blotting-paper gives an irregular, ill-defined, greasy stain, not very marked.	—does not melt so smoothly or readily on the tongue, but for a long time a roughness remains upon it, *increasing as it melts*. The stain is a circular, well-defined, oily spot, which soon becomes surrounded by a less greasy halo. (The perfection of this stain appears to vary with the quantity of the adulterant.)

These tests are such as may be readily applied by a wholesale or retail purchaser. These are by no means all the signs easily applicable for distinguishing this form of adulteration. Should the present paper receive insertion and be acceptable to your readers, I shall be happy to furnish others which have resulted from my investigations on this subject. It is one especially interesting to me, since it is believed that at Belle Isle—a nest of nuisance factories in my parish—the material for the adulteration of butter is manufactured to a great extent for exportation. The "fresh" butters are those chiefly and to the greatest amount adulterated with this fat.

Parochial Laboratory, Islington, November 12.

[We shall be glad to receive further communications from this Correspondent.—Ed. C. N.]

Researches on the Separation, by the Wet Way, of Gold or Platinum from Tin and Antimony. Reduction of Perchloride of Iron by Platinum, by MM. A. Béchamp *and* C. Saintpierre.

It is not a matter of indifference as to which ferrous compound is made use of as a reducing agent. The sulphate and chloride reduce nitric acid of the metallic or organic nitrates, and gold from the chloride of gold, but they do not reduce nitro-benzole and analogous nitro-compounds, or bichloride of platinum. By substituting ferrous acetate for sulphate and chloride, all these compounds are reducible, and platinum especially is reduced to a metallic state.

Profitting by these indications, we propose to separate, by the wet way, gold and platinum from tin and antimony. We have previously proved that neither ferrous chloride nor acetate will reduce either chloride of antimony or bichloride of tin, even by boiling, and that qualitatively it is easy to precipitate gold and platinum by ferrous acetate in presence of these chlorides. The gold may even be precipitated, in the first instance, by protochloride of iron from a solution containing tin, antimony, and platinum, and the metal exactly estimated.

On our endeavour to estimate platinum which had been precipitated by acetate of protoxide of iron, we found this problem complicated by many difficulties which we first of all strove to overcome. The chief difficulty we met with was, that, though all the platinum was precipitated by acetate of iron, its weight was generally too low. We then reflected on the peculiar nature of platinum, and particularly on the fact that a body so difficult to attack might furnish a chloride irreducible by protochloride of iron. From this conjecture to the supposition that platinum might be a reducing agent there was but a step. In effect, platinum reduces perchloride of iron into protochloride, and is

itself dissolved in the liquid in the state of bichloride, according to the equation $Pt + 2 Fe_2Cl_3 = Pt Cl_2 + 4 Fe Cl$.

The weights of the reduced platinum were too low, because in freeing it by hydrochloric acid from the peroxide of iron precipitated with it a portion was redissolved, by virtue of an inverse reaction. This new and unexpected property of platinum we have established by the following experiments:—

1. Reduce 10 cubic centimètres of bichloride of platinum, containing 0·117 grammes of metal, by ferrous acetate. Next day add some perchloride of iron and a little hydrochloric acid, and after boiling two or three hours, all the platinum is redissolved.

2. Reduce in the same manner 5 centimètres of the same bichloride, containing 0·0585 grammes of platinum, and as soon as possible heat the precipitated metal with perchloride of iron. Ten minutes' boiling redissolves the whole.

3. Heat in a sand bath, with a solution of perchloride of iron acidulated with hydrochloric acid, 0·291 grammes of spongy platinum, prepared by the calcination of chloro-platinate of ammonia. Carefully add from time to time weak hydrochloric acid to maintain a constant volume. After eighteen or twenty hours' action between 80° and the boiling point of the mixture, all the platinum is dissolved.

4. 0·05 grammes of platinum black prepared by Liebig's process with hydrochloric acid, is not attacked after prolonged boiling with hydrochloric acid. Twelve hours boiling will completely dissolve it in perchloride of iron.

5. A platinum plate thoroughly cleaned with boiling hydrochloric and sulphuric acid, and then made red hot, weighed 3·294 grammes. Then it was heated in the same manner as indicated above with perchloride of iron. After twenty-one hours it was washed, heated, and weighed. Its weight was not more than 3·243 grammes, having lost 0·051 grammes. The platinum, then, is dissolved with difficulty in proportion as it is less divided and more dense.

The hydrochloric acid and perchloride we employed contained no free chlorine. That the dissolving of the platinum might not be attributed to the accidental presence of chlorine, we took care in each experiment, by means of red prussiate, that the perchloride of iron should be partially reduced into protochloride, forming Turnbull's blue. The perchloride was prepared by the process we published in 1859—the chlororation of a protochloride of iron solution by chlorine. This compound gives no precipitate, and not being coloured blue by red cyanide, the accidental presence of chlorine is then out of the question. Consequently, if protochloride of iron does not reduce bichloride of platinum, it is because platinum in this case is the more powerful reducing agent.

It would be interesting to study from the same point of view the metals partaking of the nature of platinum, palladium, iridium, &c. We propose to do this in continuation of the work which has been the subject of this memoir.—*Comptes-Rendus.*

On the Presence of Free Nitric Acid and Oxygenised Nitro-compounds in Atmospheric Air, by M. S. Cloez.

The presence of free nitric acid and oxygenised nitro-compounds in atmospheric air has not been hitherto clearly and fully established. It is important for the theory of nitrification that this apparently simple but really complicated question, confounded as it is with the question of ozone, should be experimentally resolved. To this end I have made the following observations:—

Ordinary air, collected by an aspirator at about a mètre from the earth's surface, often makes the blue colour of wet litmus paper turn permanently red.

The tincture of blue-violet litmus, contained in a bulb-tube, through which air is passed, undergoes the same change. It has been proved that the red colour is persistent after heating the liquid to the boiling-point.

This phenomenon does not take place in all seasons indifferently, but it is frequent at the beginning and end of winter.

The nature of the acid producing this coloration is determined by passing the air into a solution of pure carbonate of potash, when a notable quantity of nitrate of potash will be found in the liquid, and generally traces of alkaline chloride, but no sulphate. The air must be filtered by passing through a pellet of asbestos.

Pure carbonate of lead substituted for carbonate of potash, and placed in a long glass tube, into which air passes, absorbs the acid vapours, forming nitrate of lead, soluble in cold water, and which is crystallisable.

Iodised starched paper has not been intentionally employed to detect the nitric acid of the air, yet this reagent is more sensitive to the action of nitrous compounds than litmus-paper; for it becomes coloured almost instantaneously in air, to which is added 0·00005 its volume of hyponitric acid, whilst litmus-paper, under these circumstances, would undergo no change.

The action of artificial nitrous air on solution of iodide of potassium produces, first, a saline compound, with a slight alkaline reaction, persisting in presence of iodine, but disappearing under the influence of an excess of nitrous air.

This singular phenomenon is similarly produced with air supposed to contain ozone. The phenomenon is explicable in both cases, by admitting the momentary formation of a small quantity of nitrite of potash, its reaction being, in fact, slightly alkaline. Whatever the true cause of the phenomenon, the inference is the same,—namely, that all the ozonometric observations made according to the process devised by M. Houzeau, are as inexact as all those previously made with Schœnbein's re-agent.

The recognised existence of free nitric acid in the atmosphere accounts for the presence of ammonia in certain specimens of rust, and the almost entire absence of it in others. It is very probable that the ammonia contained in the oxide of iron, formed in free air, is the result of the combination of nitrogen, proceeding from the reduction of nitric acid, with the hydrogen produced by the simultaneous decomposition of water. If this is the case, it is easy to understand that rust formed in humid air, freed from acid vapours, ought not to contain ammonia, like that formed in free air.

The formation of verdigris on unvarnished bells and bronze statues may be also, in a great measure, attributed to the free nitric acid of the air. An examination of green matter taken from a bell exposed to the inclemencies of the weather since 1793, has shown the presence of nitric acid.

In regard to agricultural science, the presence of nitrous compounds in the air is of the greatest importance: it accounts for the good effects of slight and superficial liming as well as marling; in short, it helps to explain the success of the agricultural practice of which M. Chevreul has recently given the theory and

set forth the advantages,—namely, the operation of *ecobuage* with combustion, originated by the Marquis of Turbilly, and carried out by him on a vast scale and with complete success.—*Comptes-Rendus.*

Rubidium and Cæsium.

PROFESSOR BUNSEN announces that he has received a considerable quantity of a *lithioniferous mica*, containing more than three per cent. of cæsium and rubidium, and, consequently, suitable for the preparation of these new bodies on the large scale. M. Seybel, the head of a large manufactory of chemical products at Liezing, near Vienna, has procured large quantities of lepidolite from Rozena, in Moravia, and of lithioniferous mica from Finnwale, in Bohemia, in order to extract from them *lithia*, *cæsia*, and *rubidia*.

PHARMACY, TOXICOLOGY, &c.

On the Copper Test for Sugar, by JOHN HORSLEY.

A FEW weeks since the CHEMICAL NEWS contained a review of "Braithwaite's Retrospect," in which allusion was made to a new cupreous preparation, by Dr. Pavy, for the detection and estimation of sugar, which he recommended as being superior to either Barreswill's or Fehling's. In that respect I differ with him, having tried his method, and object to it on account of the excess of caustic potash it contains, having known instances where the copper was reduced *per se* on standing.

Like the Doctor, I have been so dissatisfied with the reduction by copper solutions as to direct my attention to other agents, till I found out that it was not so much the test itself as the mode of manipulation that required improvement, the copper test being delicate enough when well prepared and the saccharine fluid sufficiently pure. The ordinary method of procedure is, I believe, pretty much as described by Dr. Pavy,—viz., to boil and decolorise the cupreous liquor by the addition from time to time of the saccharine solution, it being generally supposed that the powers of the sugar are defunct at the moment the blue colour disappears, than which nothing is more fallacious, the sugar being then in excess, as may be proved by a further addition of the test and re-boiling. In fact, you may even make such an addition of the test as that, on boiling and filtering, the liquor shall pass through highly coloured and yet contain sugar, which will not cease to reduce copper till after two or three other boilings and filtrations have been made. The filtered liquid being permanently blue or bluish-green, and yielding no further red precipitate after several minutes' boiling, is the alone criterion of the exhaustion of the sugar, which is just the inverse of the present method. The filtered blue liquid may be again rendered available for other reductions by concentration or evaporation down to about the tone of the original copper solution used. The following is the formula by which I make the solution of copper:—Sulphate of copper, half-a drachm; distilled water, three ounces. Dissolve by heat, then add, tartaric acid, half-a-drachm; and, when cool, caustic potash, one and a-half drachms; and, lastly, pure carbonate of potash, one and a-half drachms. An ounce of this liquor boiled with half-a-grain of grape sugar, dissolved in a little water, gave a scarlet red precipitate of one and a-half grains, every three parts representing one of sugar. The $\frac{1}{240}$th part of a grain of sugar produces a decided precipitate.

Diabetic urine ought to be purified by precipitation with excess of sugar of lead, and any remaining lead thrown out by passing a stream of sulphide of hydrogen, the liquid filtered and evaporated to about half its bulk previous to applying the cupreous liquor; but if the quantity of lead salt be nicely adjusted, there will be no necessity for using the gas. High-coloured urine, supposed to contain sugar, requires, in addition to the precipitation by lead, to be decolorised by animal charcoal, and before using the test any lime which may have been acquired from the charcoal should be extracted by boiling the filtrate with a little carbonate of potash and filtering. Such urine will not afford, like true diabetic urine, a red precipitate, but a muddy, yellow one, if sugar exist at all, and the filtered liquid, instead of being blue, will be yellowish green.

Although it has been stated, on the authority of Brücké and others, that sugar obtains in ordinary or healthy urine, I have not been able to verify it by tests, owing probably to not having operated on a sufficiently large quantity. The only way of proving it, I presume, would be by carefully evaporating to an extract the purified urine and adopting the fermentation process.

Laboratory, Police Station, Cheltenham.

On the Properties of Sulphate of Aniline.[1]

DR. TURNBULL, of Liverpool, read a paper "On the Properties of Sulphate of Aniline"—a new remedy which he had used with success in the treatment of chorea, or St. Vitus's dance. He said that medical men had not acquired a knowledge of the properties of new remedies commensurate with the advances which had been made in other branches of medicine. The progress of organic chemistry had brought to light many new bodies worthy of investigation; and there could be little doubt that many of them would, if their properties were investigated, be found to prove remedies of utility. The artificial alkaloids were a numerous class, and from a resemblance in chemical constitution to the vegetable alkaloids, such as quinine, morphia, &c., it might reasonably be expected that some of them should have powerful and useful properties. He had made some trials of more than one of them, and especially of the sulphate of the artificial alkaloid aniline, which he had administered in cases of nervous disorder. He then proceeded to give an account of six cases of chorea which he had treated successfully with this new remedy. The first was a case of a girl, aged thirteen, who had involuntary twitching movements in all the limbs, and was for two months under the usual treatment, but without deriving the slightest benefit till the sulphate of aniline was given. She then recovered rapidly, and got quite well. The second was a case in which the left side was chiefly affected, and the recovery was perfect in twenty-one days. The third was a case in which the twitching movements were brought on by a fright, and the recovery took place in fourteen days. The fourth and fifth were cases of recovery from the ordinary form of the disease. The sixth was a case of unusual severity, with partial loss of power of the lower limbs and inability to speak. Rapid and perfect recovery was, however, effected in this case by means of the same remedy. He adverted to two other cases in which sul-

[1] Read before the British Association.

phate of aniline had been used with success by other medical men: and he expressed the conviction that it would be found by the profession to be a valuable new agent in the treatment of this class of nervous diseases. In regard to the physiological action, he stated that aniline appeared to act directly on the nervous system. The most remarkable effect, however, which it produced was a transient alteration in the colour of the skin and lips, which he attributed to oxidation of the aniline and the formation of a colouring matter in the blood. But this, it was observed, must be speedily eliminated from the system, as the natural colour was restored as soon as the remedy was laid aside.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 21, 1861.

Dr. A. W. Hofmann, *F.R.S., President, in the Chair.*

Peter Macowen, B.A., Professor of Chemistry at Huddersfield College, was elected a Fellow.

Dr. Thudichum read a paper "*On Leucic Acid.*" He commenced by stating that the present paper contained an account of one of a series of researches on the products of decomposition of albuminous substances, either by reagents, or within the system. It had been known for some time that fibrin, under the action of hydrochloric acid, produced two bodies—leucine and tyrosine, and that various substances were produced within the body by decomposition under modifying circumstances, as, for instance, cholesterin, which sometimes forms biliary calculi. Leucine appeared to occur in different parts of the body, both normally and abnormally, and particularly in the pancreas; while, in the diseases classed under the name of atrophy, it appeared to be formed in the liver. The relation known to exist between alanine and lactic acid, the presence of which in the system is supposed to be the cause of rheumatic fever, had suggested the idea that there existed an acid body bearing a similar relation to leucine. This acid was already known, and a method of preparing it had been published in Liebig's *Annalen*—namely, by the action of nitric acid on leucine. In preparing this acid it was better to employ an excess of leucine; a mixture of leucic acid and nitrate of leucine would be obtained, from which the leucic acid might be separated by evaporating the solution, and treating the residue with ether; evaporating the ethereal solution, and drying the residue over sulphuric acid; or ether might be employed without previous evaporation; but the complete removal of the acid was then more difficult. The acid obtained in this manner was contaminated with an oily substance, which could be removed by pressure, or by solution in water. The properties of the acid were as follows:—It has when solid the consistence of hard soap; it reddens litmus, and decomposes alkaline carbonates; is soluble in water, alcohol, and ether, and fuses below the temperature of boiling water; on exposure to heat it gradually alters to an oily liquid, this same oily substance is always formed when a solution of the acid is heated. The composition of this substance is represented by the formula $C_{12}H_{12}O_6$, leucine being $C_{12}H_{13}NO_4$, from which it is evident that these bodies have the same relation to one another that lactic acid has to alanine. Nitroleucic acid was formed by the action of nitric acid; this substance was insoluble in ether, but if leucic acid was present it dissolved to some extent. Various salts of leucic acid were then described, more especially the lead and mercury salts, which when precipitated presented under the microscope an appearance resembling the yeast plant, and even seemed to grow in the same manner. The composition of these salts was represented by the general formula $C_{12}H_{11}MO_6$.

Dr. H. Bence Jones read a paper "*On the Occurrence of Phosphate of Lime in the Human Urine.*" Various diseases had been supposed to give rise to such deposits in the urine, more especially diseases of the nervous system and the brain. Dr. Roberts had, however, pointed out that, by adding chloride of calcium and neutralization, a deposit of phosphate of lime could be obtained in the healthy secretion. It appeared that, by employing both these reagents together, a deposit could always be obtained, and that sometimes the addition of the lime salt alone was sufficient; at other times neutralization caused a deposit, no additional lime being necessary. Deposits were formed by mixing solutions of chloride of calcium and phosphate of soda; and the resulting compounds were compared with those obtained in urine. Doses of lime-water and of acetate of lime were given to a patient at St. George's Hospital who had been suffering from dyspepsia, and who had nearly recovered; a deposit was obtained with some difficulty, but a dose of one pint of lime-water daily, or thirty grains of acetate of lime, was always found to be sufficient.

Dr. Thudichum remarked that the crystals obtained by such treatment were often so minute that a microscope was necessary to discover their presence; also that bitartrate of potash and carbonate of soda, when given internally, would cause similar deposits, generally little globular concretions, in which the crystals radiated from the centre to the circumference, these concretions varying from the size of a pin's head to that of a pea, and consisting of pure phosphate of lime, oxalate of lime being also formed at the same time, and that the administration of nitric acid removed both these deposits.

The President inquired what was the composition of the phosphate of lime deposit?

Dr. Bence Jones replied, that that point had already been determined, the crystalline deposit being composed of two equivalents of lime, one of water, and one of phosphoric acid; and the amorphous compound of three equivalents of lime and one of phosphoric acid.

Mr. E. J. Mills read a paper "*On Sparteine.*" A doubt had been raised as to whether the formula usually given for sparteine—namely, $C_{15}H_{13}N$—was correct; in fact, Gerhardt, finding that it was difficult to represent the composition of this substance by his nomenclature, had concluded that the formula should be altered to $C_{16}H_{12}N$. It appeared that the best method of drying this substance was to treat it with sodium, for that exposure over sulphuric acid failed to remove all the water. A careful analysis of this body corroborated the formula originally given by Dr. Stenhouse; it appeared to be a diamine of a composition represented by the formula $C_{15}H_{26}N_2$, and homologous with nicotine, $C_{10}H_{14}N_2$. The salts of this base were described, the platinum salt had the composition $C_{15}H_{26}N_2$, $2HCl + 2PtCl_2 + 2H_2O$; the gold salt, on the contrary, contained one equivalent each of chloride of gold and of chloride of sparteine. By the action of iodide of ethyl on sparteine, a compound of the composition $[C_{15}H_{27}(C_2H_5)N_2]''I_2$ was obtained, which was not decomposed by caustic potash, and on treatment with oxide of silver gave the corresponding base. The platinum salt of this base was analysed, and compounds with chloride of zinc were formed. The action of iodide of ethyl on a solution of the base in methylated spirit gave a product, the composition of which was still doubtful.

Dr. Stenhouse drew attention to the very small number of natural volatile bases that had been discovered, although a great many had been formed artificially.

Dr. Odling said that a great variety of volatile bases were formed during the spontaneous decomposition of nitrogenous bodies. He also alluded to volatile bases that had been obtained from sewage.

The President remarked that trimethylamine had been

obtained as a product of the decomposition of human urine. He afterwards alluded to some compounds that he hoped soon to be able to produce from benzol and its homologues, bearing the same relation to the aniline compounds that the diatomic ethylene bases did to ethylamine. The action of reducing agents on binitrobenzol had been tried by different experimenters, with the view of forming a diatomic base, but with unsatisfactory results. He had, however, lately received from Dr. Oppenheim a crystalline body contained in the refuse from some aniline works at Paris, which, on examination, appeared to have the composition

$$C_7H_{10}N_2 \text{ or } \left.\begin{matrix}(C_7H_6\\H_2\\H_2\end{matrix}\right\} N_2.$$

This compound had been produced on account of the impurity of the benzol employed in the manufacture of aniline; toluol being present in some quantity. He had found that the action of metallic iron and acetic acid on binitrotoluol completely verified this conclusion. Binitrobenzol was then submitted to the action of the same reagents, and was reduced and furnished the corresponding base, salts of this base had been prepared, the chloride had the composition

$$\left.\begin{matrix}C_6H_4\\H_2\\H_2\end{matrix}\right\} N_2 2HCl.$$

With chloride of cyanogen and other reagents, the new compound underwent similar changes to the aniline itself. It was possible that besides these compounds, others corresponding to the ammonias of the highest order could be produced by changing the bases already obtained to nitrocompounds and acting on these by reducing agents.

It was announced that at the next meeting papers would be read by Dr. Oppenheim "*On the Camphor of Peppermint;*" Mr. G. C. Foster "*On Piperic and Hydropiperic Acids;*" Professor Bolley "*On the Physical Properties of some Alloys of Lead and Tin;*" and "*On the Dangers Produced by Feeding Steam Boilers with Certain Waters.*"

NOTICES OF PATENTS.

617. *Obtaining Fresh Water from Salt Water.* D. Hebson and W. G. Ramsden, Liverpool. Dated March 13, 1861.

The arrangement of apparatus for carrying out this invention is described as being particularly applicable on board steam-ships, for the purpose of procuring by distillation supplies of fresh water from the sea. The steam boilers ordinarily working in connexion with the engine are likewise placed in communication with a cylindrical or other conveniently-shaped vessel containing the sea-water to be submitted to distillation. The pipes conveying the steam may either dip directly into the sea-water, or pass through this second vessel in the form of a coil or multitubular arrangement. In any case, the object of the invention, as stated by the patentees, consists in the employment of steam as a means of heating and causing the evaporation of salt water. From the upper part of the distilling chamber an exit pipe is led off, which conducts the steam therein generated through a worm tube or other condensing arrangement immersed in cold water. In this manner, a supply of fresh, drinkable water is procured by distillation at ordinary pressures; but, in the event of the steam-ship being provided with engines having surface condensers, it is proposed to open a communication between these latter and the evaporating vessel, with the intention of carrying out the process at lower temperatures by the creation of a partial vacuum.

In the construction of this apparatus there is an obvious anomaly in respect to the intervention of the second receptacle for sea-water. A very simple intermediate contrivance would effectually prevent the escape of particles of liquid and solid matters which are liable to accompany the steam generated in the ordinary engine boilers. It would, therefore, surely be easier to procure the evaporation of the salt water at once from the boilers, than to proceed upon an indirect system of conducting steam from a marine boiler into sea-water in order to supply the heat requisite for re-converting the contents of the second chamber again into vapour. With reference to the suggestion for conducting the process of distillation under circumstances of removed pressure, it must be remembered that the difficulties attending the condensation will, in the same measure, be augmented, and the action of the condensers themselves impaired by this adaptation to a double purpose. The aërating arrangement which constitutes an important feature of Dr. Alphonse Normandy's apparatus is here altogether omitted.

622. *Apparatus used in the Manufacture of Paper.* J. L. Jullion, Tynemouth, Northumberland. Dated March 13, 1861.

It is customary to use a felt pad of woollen material for the purpose of receiving, draining, and drying the newly made sheet of paper; the patentees employ as a substitute a fabric made of cotton or other suitable vegetable fibre.

640. *Tanning Leather.* A. F. Menard, Rue de Strasbourg, Paris. A communication. Dated March 14, 1861. (Not proceeded with.)

In this specification, which refers to a more expeditious system of tanning and preparing leather, the inventor enumerates a variety of physical conditions under which the process may be conducted; as, for instance, with the employment of a vacuum, or under increased pressure; by the injection of carbonic acid gas combined with the transmission of galvanic and electric currents, &c. &c. The subject of the eighth claim is, however, of a chemical nature, and relates to the employment of bisulphide of carbon, which, being a solvent for fatty matters, is said to have the property of rendering the leather more supple and pliable, and of conferring upon it superior waterproofing qualities.

The application of this fluid in conjunction with gutta percha and india-rubber, has previously formed the subject of a provisional patent, which will be found described at page 82 of the present volume.

642. *Certain Improvements in the Manufacture of White Lead and Other Salts of Lead direct from Ores Containing Carbonate of Lead.* John Arthur Phillips, Earl's Court, Kensington. Dated March 15, 1861.

A protest having been entered against this patent prevents us from giving the particulars of the specification.

650. *Obtaining and Utilising the Chemical Products of Spent Bark commonly called Tan.* W. Larberg, St. Mary-at-Hill, Eastcheap, London. Dated March 15, 1861.

This invention relates to the treatment of waste tan or other woody fibre by destructive distillation. When submitted to this process, the following substances are obtained as products:— Charcoal, tar and other oily matters, pyroligneous acid, and gas. The tarry substances may by a second distillation be made to furnish paraffin, creosote, and wood naphtha. The crude acetic acid may be collected in the ordinary way, or by the intervention of a metallic vessel containing alkali between the retort and condensor, the acid may be retained, without condensing much of the aqueous vapour, and the corresponding acetate produced in one operation. The permanent gas liberated during the process consists chiefly of hydrogen

and carbonic oxide, and may therefore at once be employed as a source of heat in assisting the action of the furnace; or by suitable means can be made to burn with a luminous flame, and consequently be applied to illuminating purposes.

The mode of fixing the free acetic acid in the distillate is likely to be found serviceable, but the methods of disposing of the gaseous products from wood, by rendering them available as sources of heat and light, have been anticipated.

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652. *Manufacture of Gas.* F. Trachsel and T. Clayton, Manchester. Dated March 15, 1861.

The improvements described in this invention relate to certain methods of producing light, and to apparatus for rendering hydrogen gas, carbonic oxide, and even atmospheric air and other gases luminous by the introduction of volatile substances of a combustible nature, and in such a manner that the air or gases so impregnated may be conveyed through pipes and burnt like ordinary coal-gas at its issue from properly constructed jets. The materials available for these purposes are the following:—Alcohol, ether, camphor, turpentine, and other essential oils, wood spirit, coal tar, naphtha, benzol, petroleum, and other mineral oils, caoutchouc, and similar substances. These matters are used either singly or in combination, and will be better adapted for impregnating the air or gases after they have been rectified by distillation, the products obtained below the temperature of 212 degrees Fahrenheit being preferred. When common air is to be charged with any of these hydrocarbon vapours the supply may be drawn from the atmosphere by fan blasts, bellows, gasometers, air pumps, wind-mills, or any other blowing contrivance. For the special purposes of heating hollow calendering rollers and of singeing textile fabrics, the patentees procure a suitable gas by the decomposition of steam by red-hot charcoal or scrap iron, the apparatus being made self-regulating by the action of a float valve governing the admission of the steam. For general illuminating purposes it is preferred to employ hydrogen generated by the action of acids upon corrodible metals, or the mixture of hydrogen and carbonic oxide as procured by passing steam over heated charcoal; these gases being subsequently rendered luminous by the employment of one of the hydrocarbons enumerated.

The practical suggestions contained in this patent claim include much that has already been accomplished; thus, the mode of rendering air and non-inflammable gases combustible and luminous by impregnation with benzol or naphtha vapour was carried out many years ago by the late Mr. Charles B. Mansfield, as we took occasion to remark in connection with the patent of Mr. E. C. Shepard, dated January 9, 1861,[1] for a similar application. The production of a gas suitable for heating purposes by passing steam over red-hot charcoal is a fact long known and identified under the name of "White's Water Gas." And, if in this last operation iron be substituted for charcoal with a view to the preparation of pure hydrogen, we have but another version of the patent No. 593 to which we refer (page 267) for remarks equally applicable to the present specification. It could be shown, finally, that two of the substances enumerated, viz., alcohol and wood spirit, have not the property of rendering luminous the flame of hydrogen or "water gas."

Grants of Provisional Protection for Six Months.

1796. Joseph Heape Butterworth, Vicars Moss Mills, Rochdale, Lancashire, "An improved mode of, and apparatus for, heating air or for desiccating wet or moist substances."—A communication from Jérôme Eugène Tourné, New Orleans, Louisiana, U.S.—Petitions recorded July 17, 1861.

2162. James Simmons Matthews, Moore Cottage, Bowling Green Street, Kennington Park, Surrey, "Improvements in the manufacture and preparation of starch, and in the apparatus employed therein."—Petition recorded August 30, 1861.

2363. Henry Cockey and Francis Christopher Cockey, Frome Ironfoundry, Somersetshire, "Improvements in apparatuses employed in the manufacture of gas."—Petition recorded September 21, 1861.

2540. Charles Noyes Kernot, Gloucester House, West Cowes, Isle of Wight, Southampton, and Martin Diedrich Rucker, Fenchurch Street, London, "Improvements in the method of obtaining ammoniacal salts and other valuable products from liquors or substances containing ammonia, and for utilising the residuum."—Petition recorded October 11, 1861.

2605. Hugh Macmeikan, Stratford, Essex, "Improvements in smelting, copper, gold, and other ores."—A communication from Roland Vounder Rodda, Alberton, near Adelaide, South Australia.—Petitions recorded October 18, 1861.

2654. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in preventing and removing deposits in steam boilers and other vessels, and in the apparatus employed therein."—A communication from Joseph Harrison, Philadelphia, U.S.

2656. Isac Louis Pulvermacher, Oxford Street, London, "Improvements in apparatuses for the production of galvanic and magneto electric currents, and in machinery employed in making some of the apparatuses."

2661. Timothy Morris, Robert Weare, and Edward Henry Craddock Monckton, Trafalgar Square, London, "Improvements in magnets, induction coils, and in insulating wire, and metal for electric and other purposes."

2665. John McCall, Hounsditch, London, and Bevan George Sloper, Walthamstow, Essex, "An improvement in the preservation of articles of food."

2679. James Lobb, Gunpowder Works, Dartmouth, Devonshire, "Improvements in gunpowder suitable for blasting."—Petitions recorded October 25, 1861.

2695. Emory M'Clintock, Mulberry Street, New York, U.S., "Improvements in the manufacture of soda and sulphuric acid."

2707. Frederick Bennett, Bagillt, Flintshire, "An improvement in the manufacture of spelter."

Notices to Proceed.

1695. Peter Spence, Newton Heath, near Manchester, "Improvements in economising the manufacture of sulphuric acid, and in obtaining copper from ores used in such manufacture."—Petitions recorded July 3, 1861.

1709. Osmund Williams, Dursley, Gloucestershire, "An improved mixture or liquid for extinguishing fire, applicable also for preparing or saturating various kinds of materials and fabrics, for the purpose of rendering the same non-inflammable."

1822. Michael Henry, Fleet Street, London, "Improvements in the production of paper pulp, and in bleaching paper pulp and certain fabrics; also in apparatus for cutting wood applicable for carrying out part of the invention."—A communication from Marie Anne Pelagie Veronique Cauzique, Boulevart St. Martin, Paris.—Petition recorded July 19, 1861.

1845. Nicolas Etienne Dumesnil, Rue aux Loups Sotteville-les-Rouen, France, "Improvements in materials for lubricating parts of machinery, and for other lubricating purposes."—Petition recorded July 23, 1861.

1936. Joseph Lewes, Rathmines, Dublin, "Improvements in producing and treating printing surfaces, in producing and preparing transferring surfaces, in transferring, in producing impressions on an altered scale, in preparing or treating surfaces of lithographic stones, and

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[1] Chemical News, Vol. iv., p. 122.

in obtaining devices or designs; also in agents and apparatus used in some of such improvements, parts of the invention being also applicable to photography, and to ornamenting pottery, porcelain, and glass."—Petition recorded August 3, 1861.

2162. James Simmons Matthews, Moore Cottage, Bowling Green Street, Kennington Park, Surrey, "Improvements in the manufacture and preparation of starch, and in the apparatus employed therein."—Petition recorded August 30, 1861.

2295. Henry Constantine Jennings, Great Tower Street, London, "Improvements in treating hides and skins."—Petition recorded September 14, 1861.

2482. Thomas Goulston Ghislin, Hatton Garden, London, "Improvements in the treatment or preparation of certain foreign plants or vegetable substances, and in the application of the same to various useful purposes for which horn, shell, whalebone, indurated leather, fish skin, ivory, bone, hard wood, and compounds of india-rubber or gutta-percha have hitherto been employed."—Petition recorded October 4, 1861.

2707. Frederick Bennett, Bagillt, Flintshire, "An improvement in the manufacture of spelter."

CORRESPONDENCE.

Test for the Purity of Acetic Acid.

To the Editor of the Chemical News.

Sir,—I shall esteem it a favour if you would kindly insert the following in your next publication, for the benefit of those interested in the manufacture of pure acetic acid.

Whilst making experiments on pyroligneous acid with a view to make pure acetic acid, I have been at a loss for a delicate test to ascertain when the acetic acid is entirely free from "empyreuma," which, hitherto, I have found very difficult (when so dilute as not to be tasted or smelt), and I am not aware of a good test for that purpose; but I have found, by neutralizing the acetic acid suspected to contain "empyreuma," or "empyreumatic oil," by carbonate of soda or potash and adding a solution of permanganate of potash (Condy's fluid), that, if pure, it remains pinky and unaltered, but if it contains the slightest trace of empyreuma, the permanganate of potash is immediately decolorized, and after standing a short time, a brown precipitate is produced, but this is not the case when the acetic acid is absolutely pure.

I am, &c. John Lightfoot.

On the Copper Test for Sugar.

To the Editor of the Chemical News.

Sir,—In reference to the Copper Test for Sugar, I have just made a few experiments to ascertain its amount of sensitiveness, and I find that a sensible precipitate may be obtained by the $\frac{1}{210}$ of a grain of sugar, which is much greater than Dr. Bence Jones' estimate, which is only $\frac{1}{20}$. This can be proved by boiling a drop of the sugar solution with the copper fluid in a capsule, and then projecting it into a test-glass and observing the precipitate which falls on cooling.—I am, &c.

John Horsley.

Chemical Notices from Foreign Sources.

I. MINERAL CHEMISTRY.

Compounds of Ammonia with the Salts of Copper and Cobalt.—Schiff considers (*Comptes Rendus*, t. liii. p. 410) that the compounds of ammonium with the salts of copper may be derived from four ammoniums. (Am. = NH_4.)

$N\begin{cases}Cu\\H\\H\\H\end{cases}$ Cupriconium. $N\begin{cases}Cu\\Am\\H\\H\end{cases}$ Amicupriconium. (Cu = 32)

$N\begin{cases}\overline{Cu}\\H\\H\\H\end{cases}$ Cuprosonium. $N\begin{cases}\overline{Cu}\\Am\\H\\H\end{cases}$ Amicuprosonium. $\overline{Cu} = 64$

The author has obtained a variety of salts of the two first bases by decomposing the sulphate of amicupriconium with the various salts of baryta, or by dissolving the cupric salts in ammonia.

The salts of the peroxide of cobalt which contain the triatomic radical, $Co''' = 59$, give triatomic ammoniums; and the protoxide salts containing the monatomic $Co' = 29{\cdot}5$, give a monatomic base, which under the influence of ammonia and oxygen will form an intermediate diatomic base.

The author intends to show in future papers that the compounds of ammonia with the peroxide of chromium, aluminium, iridium, and other triatomic metals, may be described as the above.

II. ORGANIC CHEMISTRY.

Spontaneous Decomposition of Gun-cotton.—M. Bouet (*Comptes Rendus*, t. liii. p. 405) has remarked that the decomposition of gun-cotton in diffused light is preceded by the appearance of a reddish atmosphere, and also that the cotton prepared with nitrate of potash and sulphuric acid is sooner and more violently decomposed than that prepared with the mixed acids. The residue, he says, is also different in the two cases: that of the first is something like burnt sugar, and in the second case is of a straw colour. In both cases the sides of the bottle were nearly covered with small crystals of oxalic acid, and the air contained had an acid reaction. M. Bouet demonstrated the presence of carbonic and formic acids in the atmosphere of the bottle, and he thinks it probable that cyanogen was present. No oxide of nitrogen was discoverable. The solid residue after the removal of the oxalic acid was white, and dissolved in water like gum.

M. Chevreul agreed with M. Bouet, but insisted that light was an active agent in decomposition only when air was present; and among other things he insisted on the importance of light in a sanitary point of view, the salubrity of a house greatly depending on the free admission of light as well as air.

Luca found, however, (*Ibid.* t. liii. p. 298) that gun-cotton which had been kept in the dark had undergone decomposition with the evolution of nitrous vapours. Nearly the whole of this "modified" cotton he found to be soluble in alcohol and in water—14 per cent. in the former and 78 per cent. in the latter. The products of the decomposition he intends to study further.

Transformation of Propionic into Lactic Acid.—MM. Friedel and Machuca (*Comptes Rendus*, t. liii. p. 408) heated propionic acid and bromine in a sealed tube and obtained bromopropionic acid which they found to act readily on oxide of silver in the presence of water. They then passed sulphuretted hydrogen through the silver solution and so procured a strongly acid liquor, which neutralized with oxide of zinc and evaporated yielded crystals exactly resembling ordinary lactate of zinc. Analysis, and the formation of other salts, confirmed the identity of the lactic acid formed as above with that obtained by the usual fermentation process.

Patagonian Guanos.—M. Malaguti gives an account (*Comptes Rendus*, t. liii. p. 436) of a few guanos brought from a group of small islands lying off Port Desire, on the coast of Patagonia. His analyses do not differ much except in one case, from those published here; but the

guano brought from Penguin Island appears to be remarkable from the amount of phosphate of alumina it contains. The whole amount of phosphates which this guano, according to M. Malaguti, contains never exceeds 35 per cent., and the greater part of this is phosphate of alumina. This, the author remarks, is not a common fact; but what makes it more remarkable is, that in consequence of the presence of this salt, the earthy part of the manure is more soluble in acids before calcination than after. This is an important fact for chemists who are expected to give analyses of manures in a very short time. The phosphate of alumina is seen in the guano as a multitude of small white globules, which are easily reduced to powder by pressure. Only from 4 to 4·35 per cent. of nitrogen is present in Patagonian guanos.

Blue Colour from Cotton Seed Oil.—Cotton seed oil is bleached by treatment with either carbonate of soda or caustic lime. In both cases a considerable residue is left after drawing off the bleached oil. This residue is treated with sulphuric acid, and distilled at a high temperature. There is then left, according to M. Kuhlmann (*Comptes Rendus*, t. liii. p. 444), a compact mass of a deep greenish blue colour. On further treatment of this mass with strong sulphuric acid, the green tint disappears, and a very intense pure blue colour is produced. Other acids, phosphoric and hydrochloric, will bring about the same change. The blue mass is a mixture of the coloured substance with some sulphuric acid, sulphate of soda, and fats. The two former may be removed by washing with water; the latter by treatment with naphtha. Alcohol now dissolves the blue colour, and water precipitates it from the solution chemically pure.

According to the mean of the results of three analyses, the composition of the new body was

C 70·24
H 8·35
O 21·41:

results which nearly agree with the formula $C_{34} H_{24} O_8$. The new matter could not be obtained crystallized.

Unhappily, M. Kuhlmann has not yet been able to dye with this colour, but he does not despair of fixing it.

Transformation of Cane Sugar into Pectic and Malic Acids.—Schoonbroodt (*Bulletin de la Société Chimique, &c.* No. iv. p. 77) mixed two parts of cane sugar with one of hydrate of lime, and then added three parts of pure and dry chloride of lime. This mixture he made into a thin paste with distilled water, and then let it alone for a time. A lively reaction soon set in, the mixture became heated, and chlorine was evolved. When the swollen mass was afterwards treated with boiling distilled water, it formed a bulky jelly, in which the author found among various other things, pectate of lime. Here is the explanation of the reaction:—

$$2\,C_{12}H_{11}O_{11} + 3\,CaO,ClO = C_{24}H_{15}O_{21},2\,HO + 3\,CaCl + 5HO$$

When the quantity of chloride of lime was doubled, a different result was obtained. In this case the reaction was slower, and the solution, though slightly gelatinous, would go through a filter. When this solution was evaporated to a syrupy consistence, and afterwards treated with alcohol, it deposited a white powder, which M. Schoonbroodt satisfied himself was mostly malate of lime. The malic acid, when isolated, behaved exactly like the natural acid. The formation of the malic is explained by the following equation:—$C_{12}H_{11}O_{11} + 3\,CaOClO = 3\,(C_4H_2O_4, HO) + 2\,HO + 3\,CaCl$. The author wishes to draw the attention of chemists to the above facts, assured that their researches will fully confirm all he has advanced. He is anxious also to have his claim to priority of discovery acknowledged.

MISCELLANEOUS.

Chemical Society. — The next meeting of this Society will take place on Thursday, December 5, when Papers will be read by Dr. Oppenheim "On the Camphor of Peppermint;" Mr. G. C. Foster "On Piperic and Hydropiperic Acids;" Professor Bolley "On Some Physical Properties of Tin-Lead Alloys;" and "On the Dangers Produced by Feeding Steam Boilers with Certain Waters."

Poisoning Noxious Animals.—On account of the numerous accidents which have occurred from using arsenic and phosphorus for this purpose, M. Sevérin Caussé, at the request of the French Government, has been pursuing a series of investigations with the object of devising some means of poisoning which should be as efficacious and more safe than those in use. As general principles he lays down these rules:—1. That we must not risk mistakes by employing the poison in the form of biscuits, pills, or powder; 2. An excipient must be used which is repugnant in taste to man but not to animals; 3. Emetic substances should be added, so as, in case of the poison being swallowed accidentally, vomiting may be produced, which is not with gnawing animals like rats and mice; 4. The substance should be easily detectable by chemical analysis; 5. The composition he finally recommended as the best suited as a destructive agent, consists of tallow 786 grammes, tartar emetic 153 grammes, and euphorbium 51 grammes. These, mixed with a pinch of aventurine (added for facility of detection in case of human poisoning), by the aid of 10 grammes of cotton, are made into thirty-two candles, each of which would suffice to poison several rats or mice.—*Annales d'Hygiène*, vol. xv., p. 425.

Scientific Education.—Perhaps there never was a time when scientific knowledge was at a greater premium than it is at present. The system of competitive examination, now so common in the Government departments, and especially in the Indian Service, has created a considerable demand for scientific education. Unhappily, this demand has hitherto been very inadequately met. Scientific instruction has, with rare exceptions, been quite foreign to the ordinary curriculum of our upper and middle-class schools. Amongst the honourable exceptions must be classed the Scientific and Engineering School attached to the College at Chester, under the principalship of the Rev. Arthur Rigg, F.S.A. This gentleman, himself of high scientific attainments, was one of the first, if not *the* first, to recognise the increasing importance of scientific education to the youth of England, and it was at his suggestion and through his exertions that the Chester School was established. Its success has demonstrated the soundness of Mr. Rigg's views. The school has long been held in high repute by scientific men, and we are glad to learn that the Secretary of State for India has formally recognised it "as possessing an efficient class for civil engineering." There is one feature peculiar to this school which we should like to see more common,—a portion of each day is set apart to work in the laboratory and workshops. Thus, theory and practice are combined. We shall be glad if the success of the Chester School leads to a more general introduction of the scientific element into middle-class education.

Alchemy in the Nineteenth Century.—The following astounding *canard* is being extensively quoted in American papers:—"It has been a great mystery to English bankers, and to the Directors of the Bank of England, how the bullion of the Bank of France could be so greatly increased within the last three years, while the institution has been constantly sending gold to England,

to Germany, and to America. Not long since the Bank of France drew some fifteen millions francs in silver from the Bank of England, which it paid for in gold bars with the French Mint stamp on them. At its last report it showed a balance of one hundred and seventeen million francs in gold, while the amount one year ago was under eighty millions,—nearly one-third increase. It is whispered that this abundance in gold is the result of a scientific discovery, which the Emperor Napoleon has secured the monopoly of. Gold is at the present moment manufactured at Paris in a secret manner. The principal articles used are lead and arsenic, and though it is not known how extensively the precious metal is produced, yet several hundredweight of the material are taken to a certain place on the 1st of each month. Everything is conducted with the utmost secrecy. . None of the workmen are allowed to leave, and nothing definite can be known; but the fact that gold is produced is beyond peradveuture. How long Napoleon III. will be able to keep this wonderful secret remains to be seen."

Spontaneous Generation.—The question of spontaneous generation is one of the subjects proposed for competition by the Institute, and communications are occasionally forwarded to that body by those who are likely to appear as candidates for the prize. Thus, at a recent meeting, M. Pasteur presented a work in which he endeavours to prove that all organized productions which appear in previously heated infusions, are due to the microscopic organised particles floating in the air. Another communication was also received from M. Jodin. This gentleman states that, on May 12, 1859, he took six glass tubes five inches long, and of a diameter of from seven to eleven lines, and hermetically closed at one end Each tube received equal parts of crystallized sulphate of soda and water to about one-fourth of their capacity. Three, moreover, received a weight of sugar-candy equal to one third of the sulphate of soda employed. All the tubes were then heated in a water-bath, to liquefy their contents, corked and kept inside a press, in a vertical position. At the expiration of a twelvemonth, M. Jodin examined the tubes and found that the contents of all those which had only received sulphate of soda were totally crystallized, while those which also contained sugar had remained liquid ; but this liquid was covered with a pellicle formed by a well-developed mycodermic vegetation, possessing the peculiar greenish hue of the spores of the *Penicellium glaucum*. Five minutes after the corks had been carefully removed the liquid crystallized in one solid mass. Hence it appears that the germs of the genus *Mucedinæ* (or mildew) may be developed and organised in contact with a solution of sulphate of soda, the particles which are arranged in that peculiar way which constitutes a state of excessive saturation.

Canadian Iron Ore.—In an account which appeared in the *Times* of the 26th inst., describing the loss of the Montreal steamship, *North Briton*, there is an interesting statement made relative to the occurrence of vast deposits of iron ore on Mingan, one of the Paroquite Islands in the Gulf of St. Lawrence, near which the ill-fated vessel struck and foundered. The rocks in the vicinity are said to be so greatly impregnated with iron as seriously to affect the action of ships' compasses. If this observation be correct, it points not only to the existence of vast mineralogical treasure in these islands, but affords hopeful indications in regard to the quality of these beds of ironstone ; since the magnetic ores are those which at the same time exert the most powerful attraction upon the compass needle, and are distinguished for their purity and freedom, especially from those contaminations which most seriously prejudice the quality of the iron when manufactured. The finest brands of Swedish and Russian iron are known to be smelted from ores of the magnetic oxide class, and iron is largely produced on the continent of North America from similar sources. Large supplies of pig iron from the adjoining territory of Nova Scotia have been brought into the English market ; and it would be interesting to know whether the beds of ore referred to in the foregoing narrative, have hitherto been turned to practical account.

Arsenical Poisoning.—An inquiry has this week been held by Mr. G. S. Brent, touching the death of Matilda Scheurer, a good-looking girl, aged 19, who died from poison imbibed into the system during her engagement in the manufacture of artificial flower leaves. Mrs. Louisa Scheurer, a widow, and mother to the deceased, deposed that on Thursday week her daughter was taken ill. She was seized with vomiting and the refuse of the stomach was of a very greenish colour. The witness took her to a doctor on the following morning, who told her she was again suffering from the effects of poison. She had been ill several times before, complaining of pains in the stomach and sickness, for the last year and a-half. She was engaged as an artificial florist in the warehouse of M. Bergerond, of Judd Street, Brunswick Square, and up to the time of her death she had been engaged in the leaf-making. She was in the greatest pain until she became insensible, when death put an end to her sufferings. Mr. James Thomas Paul, surgeon, of 26, Burton Crescent, said he had attended the deceased four times within 18 months, while suffering from the same causes. He had made a *post mortem* examination, and found that the lungs gave evidence of the presence of arsenite of copper, the liver being highly impregnated, as also the mesenteric glands. The cause of death was acute inflammation of the mucous membrane of the stomach, produced by the inhalation of the arsenite of copper. A sister of the deceased had died under similar circumstances. M. Bergerond said he employed 98 girls in his establishment, and for their protection he had suggested the wearing of masks, but it was objected by them as producing excessive heat. They, however, wore muslin over their mouths. It was stated by a juror that the arsenite of copper in such manufactures was prohibited in France, as injurious to workpeople. The jury returned a verdict to the effect that deceased died accidentally, from the effects of mortal disease in her stomach and other organs, occasioned by arsenite of copper used in her employment.—*Times.*

New Scientific Society.—A Society has recently been formed in Manchester, under the title of the "Scientific Students' Association." This Society owes its origin to a few scientific tyros, who, having experienced great pleasure and profit from attending the sectional and other meetings of the British Association, during the late visit to Manchester, determined to form a little Association for the benefit of the Manchester lovers of science. Mr. L. H. Grindon consented to act as Chairman, and a Committee and other officers were at once appointed, consisting mainly of the originators of the scheme. The members meet, for the present, once a fortnight, for the purpose of hearing and discussing papers on subjects connected with physical and natural science, which are illustrated, as far as possible, by specimens, experiments, diagrams, the microscope, &c. Excursions will also be occasionally arranged.—*Engineer.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

H. W.—We do not think that there is any waterproof cement known which is sufficiently strong to be used for joining broken false teeth or similar small articles when they are to be subjected to rough usage. You will find a useful series of cements described in Beasley's Druggist's Receipt Book.

Otto Richter.—Received with thanks. In our next.

THE CHEMICAL NEWS.

VOL. IV. No. 105.—December 7, 1861.

THE COMPOSITION OF THE SOLAR SPECTRUM.

IN another column will be found two papers on this subject, which merit serious attention on account of the modifications which they appear to render necessary in the recently-suggested explanation of the constitution of the sun's atmosphere. In Kirchhoff and Bunsen's original paper on "Spectrum Analysis," they state,[1] that "the appearance of the spectrum can vary considerably. If the intensity of the light be increased, new lines appear in several of the spectra (of the alkalies), and the relation of the brightness of the old ones becomes altered. In general, an indistinct line becomes brighter upon increasing the illumination, more rapidly than does a brighter line, but not to such an extent that the indistinct line ever overtakes in intensity the brighter one. A good example of this is seen in the two lithium lines." This circumstance appears, however, to have attracted no particular attention, and many of our readers remember the incredulity with which Dr. Tyndall's first exhibition at the Royal Institution, of a magnificent blue band as a constituent of the lithium spectrum, was met by the chemists present. The almost unanimous opinion was, that he had by a *lapsus linguæ*, used the word lithium for strontium throughout the evening. Dr. Frankland's article, with Dr. Tyndall's note, given in our present Number, fully clears up the apparent difficulty; whilst, at the same time, it tends to throw doubt upon some of the speculative generalisations which have been deduced from the recently-observed phenomena of the reversal of the bright spectral bands.

Taking Bunsen's estimates of the temperature of flame as correct, it is seen that the Bunsen's-burner flame (2350° C.) is not hot enough to produce the blue line of lithium, but the hydrogen flame (3259° C.) is able to bring it out. An increase of 909 degrees of temperature is, therefore, sufficient to increase by one-half the lines of lithium, whilst the heat of the electric arc raises the number of sodium lines from one to four. The same fact which Dr. Frankland has shown with regard to lithium and sodium we have proved in the case of potassium, calcium, strontium, barium, and copper; so that it may be fairly assumed, as a general law, that all spectra of incandescent elements become more complex as their temperature is raised. Now, the temperature of the sun's surface is, according to the most trustworthy authorities, stated to be equal to that due to the combustion of $\frac{3}{5}$ths of a ton of coals per hour on each foot of surface; whilst Kirchhoff's theory necessitates a temperature at which iron would be a gas. In either case the heat would as far exceed the temperatures which can be produced by artificial agency as the sun's light surpasses our terrestrial means of illumination. What, then, will be the appearance of the spectrum of a metal when exposed to the exalted temperature of the sun's surface? We are not justified in assuming that its growth in complexity stops at a certain temperature, the heat increasing, but the lines remaining the same. Experiment tends to show that the spectrum of a *solar* element is quite different to that of the same body when experimented upon in our laboratories. It would contain, in addition to the lines capable of being rendered visible by terrestrial means, a vast number of lines which only the solar temperature can evoke; and, consequently, it is exceeding the legitimate inferences to be drawn from experiment, for physicists to assume that the reversal of a few prominent lines in artificial spectra proves the metallic constitution of the sun's atmosphere. Unquestionably certain metallic lines can be reversed, but the black bands thus artificially produced in a continuous spectrum are very dissimilar in sharpness, width, and, in some cases, according to M. Morren, even in position, with the Frauenhofer lines, with which they are supposed to correspond; whilst the sharpness, nearness together, and enormous number of the solar lines are such that it would be difficult to find a line which did not correspond in position to a reversed artificial line.

Granting, however, that the differences of width and sharpness between the artificially reversed and the solar lines may be accounted for by the relative temperatures of the luminous and intercepting flames not being properly proportioned one to the other, we still think that our knowledge is at present too imperfect to justify the classification of a metal as a constituent of the sun on the strength of a few observed coincidences between the solar and the metallic fixed lines. M. Morren has shown that the so-called soda line D is a constituent of several metallic spectra besides that of sodium; unless, therefore, it can be shown that *every* line capable of being evolved from an incandescent metallic gas at the highest attainable temperature is accurately represented by a black Frauenhofer line, we cannot admit the accuracy of the deductions, but must consider the coincidences as merely accidental, and in no way related to one another in the manner of cause and effect. For instance, the line D being a constituent of the mercury spectrum, the presence of sodium in the sun's atmosphere cannot be proved by this line alone, but must be shown to be probable by an examination of the blue bands mentioned by Dr. Frankland; and in a similar way only can the probable existence of other metals in the sun be shown, not by a reversal and comparison of one or two lines merely, but by proving that *every* line which it is possible to see at the highest temperatures can be reversed into its counterpart in the solar spectrum.

[1] *Philosophical Magazine*, Fourth Series, xx. 94.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Relations existing between Atomic Weights, by M. J. S. Stas, *Member of the Royal Academy of Belgium.*

(*Continued from page* 283.)

Determination of the Proportional Relation between Silver and Chloride of Ammonium.—Upon glancing at the determination of the proportional relation between silver and chloride of ammonium performed by M. de Marignac, it is perceived that they differ considerably from one another; between the minimum and the maximum there is $\frac{1}{786}$th,—a difference five times greater than the error which belongs to the method followed by this skilful chemist. When I commenced my researches I noticed an analogous fact. After long experimental trials I succeeded in discovering the cause. It is occasioned by the property which sal-ammoniac possesses of absorbing an excess of acid. This salt, which naturally has a very decided acid reaction, even when it has been produced in the midst of a very ammoniacal medium, holds an excess of acid when it condenses after having been very strongly heated in the state of vapour.

Heat in effect decomposes sal-ammoniac, with production of nitrogen and hydrogen, and a part of the hydrochloric acid which is set at liberty condenses with the vapour of the sal-ammoniac. This double property possessed by sal-ammoniac, in common with many other ammoniacal salts, of reddening test-paper, and taking, besides, a slight excess of acid, constitutes an additional difficulty in the determination of the proportional relation of this body. With the object of overcoming this, I attempted to determine in each specimen of the salt the quantity of hydrochloric acid which there was in excess; but I especially made all possible efforts to prepare sal-ammoniac without excess of acid, in order to avoid making a correction which is uncertain.

This uncertainty arises from two causes. The naturally acid reaction of sal-ammoniac, supposing it to be of neutral composition, evidently represents a certain quantity of base; but this quantity is unknown, and there is no means of determining the amount *d priori*, and it is only by comparison that one can acquire the certainty that the degree of acidity is not identical. The method which can be employed to estimate the excess of acid is not susceptible of the precision which it ought to have in order to give absolutely exact numbers. This is evident upon examining my results with attention.

The means which I have employed to estimate this degree of acidity consist in searching how much standard solution of lime must be added to bring a given weight of the salt to neutrality, measured by litmus or turmeric.

The standard lime-water contained per cubic centimètre a quantity of base represented by 0·0003201 grammes of hydrochloric acid. It was, therefore, excessively weak, so as to require a considerable volume of liquid, and also to allow me to appreciate the smallest quantities.

In the specimens of chloride of ammonium which I have prepared for my experiments the degree of acidity varied from the $\frac{1}{200}$th to the $\frac{1}{12000}$th part of the weight of the chloride, supposing, be it understood, that the acidity is due to loss of ammonia. But, as I have already observed, the chloride of ammonium formed in the midst of a highly ammoniacal medium still reddens litmus. This supposition is, therefore, inexact, and the figure obtained necessarily includes an error, the amount of which may even be greater than the minimum quantity stated.

As I believe I have succeeded in preparing at will sal-ammoniac possessing an acidity which is scarcely superior to that which belongs to the definite compound, the difficulty which I attempted to overcome is no longer of any consequence. Indeed, I only mentioned it to explain the disagreement which the results obtained by M. de Marignac show between themselves, and the difference which may be remarked between the first four determinations and the ten following ones.

All chemists have remarked the difficulty which there is in procuring sal-ammoniac capable of volatilising without leaving any residue. Sometimes there remains a carbonaceous matter; sometimes a mixture of silica, alkaline chloride, and oxychloride of iron is obtained. Indeed, commercial sal ammoniac and the ammonia obtained from it contain compound ammonias which furnish this carbon; it also contains chloride of iron. The alkaline chlorides and the silica which is found in the residue of the volatilisation of sal-ammoniac are derived from the vessels in which the operation has taken place.

The precautions which I have taken in the preparation of the chloride to be used in my determinations have had for their object the getting rid of these impurities. It would be too long to detail here all the tedious processes which I have adopted to obtain sal-ammoniac free from all foreign substances; it would, moreover, be without interest. I will content myself with pointing out the methods employed to prepare the products which I have experimented upon.

I. Chloride of Ammonium from Commercial Sal-ammoniac.—I have purified commercial sal-ammoniac with a double object: first, to make use of it in my determinations; and, second, to extract from it pure ammonia with which to prepare the chloride of ammonium required for the treatment of the chlorides of potassium and sodium.

To destroy the compound ammonias existing in commercial sal-ammoniac, I had recourse to the following means:—A boiling saturated solution of sal-ammoniac, freed from iron and other metals by sulphide of ammonium, is mixed with a twentieth of its volume of concentrated nitric acid. The mixture is evaporated away from all organic dust. The residue being dried, is moistened again with a small quantity of nitric acid, and evaporated a second time to dryness. The compound ammonias are thus totally destroyed, with a very notable quantity of the sal-ammoniac itself.

It is from this salt, so purified, that I have extracted the pure ammonia employed in the preparation of the chloride of ammonium used in the treatment of the alkaline chlorides, by combining it direct with pure hydrochloric acid.

To transform the purified salt into pure chloride of ammonium, I sublimed it three successive times at the lowest possible temperature. The salt collected in the neck of the flask during the first sublimation always contains traces of bisulphite of ammonia. On this account I have taken to set apart all the chloride adhering at each sublimation to the neck of the flask. While the sublimed sal-ammoniac remains very warm, it is as transparent as glass, and possesses extraordinary elasticity. Upon cooling, it becomes more or less opaque, and then loses its elasticity in a remarkable manner.

The determinations Nos. I., II., III., and IV. were made with the aid of sal-ammoniac thus obtained. It was perfectly colourless, and volatilised without the least residue. As may be seen by a comparison of the results, they possessed very different degrees of acidity. The specimens submitted to experiment were taken from portions considerably removed one from the other. A portion of sal-ammoniac was sublimed a fourth time, but in an atmosphere of dry ammonia. The result given at No. V. refers to this chloride.

Another portion of the same salt was dissolved three successive times in ammoniacal water, and the salt, after drying, heated until it agglutinated. The result which it yielded on analysis is given at No. VIII.

II. Chloride of Ammonium from the Action of Pure Ammonia and Carbonic Acid upon Pure Chloride of Calcium.—I have had recourse to this mode of preparation in order to obtain at the same time a certain quantity of pure carbonate of lime.

Some beautiful white marble was dissolved in pure hydrochloric acid. The chloride of calcium so obtained was boiled with a little milk of lime prepared by means of lime from the calcination of marble in a platinum vessel. The solution of the basic chloride of calcium was filtered and evaporated to dryness; the residue was fused in a platinum vessel.

This chloride was perfectly colourless. Taken up with cold water, the alkaline and turbid solution having become clear by standing, was poured into pure water in which I had dissolved pure ammonia extracted from sal-ammoniac which had been twice treated with nitric acid. The mixture was submitted to a current of carbonic acid to the complete precipitation of the lime. The colourless and slightly ammoniacal solution was evaporated to a pellicle. The crystallised salt, separated from its mother-liquor, was dried and then twice sublimed. It was absolutely colourless at the first sublimation, and left no trace of residue at the second sublimation. No. VI. refers to the result furnished by this salt.

A portion of the preceding salt was dissolved in ammoniacal water and the solution evaporated *in vacuo* over fused potash. The resulting chloride was sublimed in platinum at the lowest possible temperature. No. VIII. gives the result of this experiment.

Another portion of the same salt was dissolved in ammoniacal water. After the crystallisation of the chloride, the alkaline mother-liquor was decanted, and the salt, which already had a decided acid reaction, was exposed under a bell-jar with caustic potash. After thorough drying, it was submitted, in the same tube in which it was to be weighed, to a current of pure dry ammonia for an entire day. The next day the current of ammonia was replaced by air freed from all foreign substance, and the current was continued for several hours after the air had ceased to carry off ammonia. The result of this experiment, made with extreme care, is found at No. IX.

III. Chloride of Ammonium Prepared by the Direct Combination of Pure Ammonia with Pure Hydrochloric Acid.—The ammonia displaced by an alkali from the chloride purified by means of nitric acid and carefully washed in water, was dissolved in water contained in a platinum vessel. The liquid, the ammoniacal odour of which differed completely from that of ammonia extracted from commercial sal-ammoniac, was then nearly neutralised with pure hydrochloric acid. Whatever might be the excess of ammonia existing in the liquid, the salt which was deposited by the action of the hydrochloric acid always presented a decided acid reaction. This salt was dried in a current of dry ammonia and the ammonia then eliminated by a current of air. It took ninety-six hours to drive off the last trace of condensed alkali. The result given at No. X. refers to this salt.

This same chloride of ammonium volatilised in a platinum vessel in an atmosphere of ammonia and then weighed *in vacuo* gave the result at No. XII.

Wishing to satisfy myself of the influence of the ammoniacal atmosphere during the volatilisation of the salt, I sublimed the preceding chloride of ammonium a second time in platinum, the salt being weighed equally *in vacuo*. The result I obtained is shown at No. XIII.

Finally, I wished to form sal-ammoniac from ammonia produced by the reduction of nitric acid. With this object, I reduced nitric acid by a mixture of zinc, sulphuric acid, and water. The solution of the sulphates of zinc and ammonia thus obtained was concentrated and then poured on to hydrate of lime contained in a large retort. The mixture was heated, to drive off the liberated ammonia, and the gas, after being washed in water, was dissolved in pure water. The ammoniacal solution presents, as to its odour, the same difference from the ammonia extracted from commercial sal-ammoniac that I have recently mentioned in the case of that derived from the purified salt. It is incontestable that the gas possesses a much purer and infinitely less disagreeable odour.

This ammoniacal solution was nearly saturated with pure hydrochloric acid and allowed to crystallise under a bell-jar with solid caustic potash. The alkaline mother-liquor was poured off and the salt dried under a bell-jar with solid potash, and then in a current of dry ammonia, afterwards replaced by a current of dry, cold air.

The resulting chloride of ammonium was of a dazzling whiteness. It was weighed in the air and gave the result at No. XI.

I evaporated to dryness the voluminous mother-liquors from which the salt had been deposited, and mixed the resulting chloride with a great excess of fused and pulverised potash. The ammoniacal gas, dried by passing through two long U-shaped tubes filled with fused and pulverised potash, was directly combined with dry, pure hydrochloric acid, in a platinum digester holding five litres, taking the precaution always to keep the ammonia in excess. The sal-ammoniac produced, which was of extreme whiteness, was heated in an atmosphere of dry ammonia until it cohered together. It was then introduced into a glass tube and submitted to a current of cold and dry air until it had lost all the condensed ammonia. It was then weighed *in vacuo* and furnished the result given at No. XIV.

To enable the following Table to be understood, I must explain that it first shows the proportional relation between silver and sal-ammoniac given by the experiments, without taking account of the excess of acid which this compound retains or may retain; and, second, according to the hypothesis that the excess of acid is saturated with ammonia, and that the weight of the salt is proportionally increased. From a comparison of the two results, it is evident that chloride of ammonium can retain an excess of hydrochloric acid, but they show, at the same time, my inability to measure exactly the degree of acidity.

Upon examining this Table, it will be seen that the results are nearly constant from No. V. When I executed the first four determinations I was ignorant of the property possessed by chloride of ammonium of retaining an excess of acid under the above-named circum-

Proportional Relation between Silver and Chloride of Ammonium.

Numerical Order.	Weight of the Sal-ammoniac in air.	Weight of the Sal-ammoniac reduced to a vacuum.	Weight of the Sal-ammoniac reduced to a vacuum and calculated as neutral.	Weight of the Silver in air.	Weight of the Silver reduced to a vacuum.	Weight of the excess of Silver after double decomposition.	Weight of the Sal-ammoniac corresponding to the excess of Silver.	100·000 parts of Silver equivalent to Chloride of Ammonium: A. Calculated from the crude Salt.	100·000 parts of Silver equivalent to Chloride of Ammonium: B. Calculated from the supposed neutral Salt.
	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.		
I.	3·3885	3·3911	3·39373	6·8504	6·85083	0·00950	0·004712	49·568	49·606
II.	3·73025	3·73312	3·73437	7·54061	7·54108	0·01290	0·00645	49·581	49·605
III.	3·00675	3·00906	3·01141	6·0791	6·07872	0·0090	0·004464	49·572	49·610
IV.	4·99675	5·00060	5·00398	10·10115	10·10093	0·01505	0·00742	49·577	49·611
V.	6·2398	6·2446	6·24652	12·6090	12·6098	0·01875	0·00930	49·595	49·610
VI.	8·0765	8·0827	8·0852	16·3206	16·3216	0·0224	0·01110	49·588	49·604
VII.	3·99975	4·00283	4·00435	8·08304	8·08354	0·0119	0·00595	49·591	49·608
VIII.	1·92130	1·92278	1·92333	3·88237	3·88261	0·0055	0·00273	49·593	49·606
IX.	11·0004	11·0088	11·0103	22·22200	22·22336	0·0300	0·01490	49·600	49·608
X.	10·92155	10·92896	10·93151	22·06600	22·06734	0·0280	0·013888	49·599	49·602
XI.	12·25095	12·26038	12·26064	24·74838	24·74991	0·0305	0·01512	49·598	49·599
XII.	22·8606	22·8769	22·88778	46·1777	16·1814	0·0567	0·02812	49·597	49·600
XIII.	23·9534	23·9714	23·9734	48·3878	48·3908	0·0533	0·0262	49·591	49·599
XIV.	24·9272	24·9257	24·9278	50·3141	50·3173	0·0551	0·0273	49·592	49·601
							Mean of the last nine Experiments ...	49·5944	

stances. In the ten following operations I succeeded in avoiding the excess of acid. Only the latter experiment could show if the compounds that I employed in the determinations could not in their turn retain an excess of ammonia. I can only say that I have used all my endeavours to avoid this cause of error.

Upon comparing the results furnished by those specimens of chloride of ammonium which were crystallised from a liquid, a slight difference may be remarked according to whether the weighing was effected in air or in a vacuum. The weighing in air is affected by an error on the plus side, owing to the condensation of this fluid by the salt. This cause of error will be easy to rectify by a subsequent experiment; I perceived it too late to take account of it.

If it is wished to calculate the mean of my experiments, it seems to me, in this case, the last ten only ought to be taken into consideration. This mean is 49·5944. Whence it results that the proportional relation between silver and chloride of ammonium is as 100·000 to 49·5944.

Determination of the Proportional Relation between Nitrate of Silver and Chloride of Potassium.—I have attempted to determine the proportional relation between nitrate of silver and chloride of potassium, in order to submit my syntheses of nitrate of silver to a rigorous control. It may be conceived that if the salt produced in these syntheses retains an excess of acid or of water, its presence could be proved in this manner. This research, moreover, would serve to verify Prout's law.

On this subject I have made three series of experiments. The first was executed with nitrate of silver prepared from pure silver, and which, after having been fused, was crystallised a great many times. The last crystallisation was hastened by cooling the liquid rapidly, so as to obtain the salt in a fine state of division. The salt, after having been kept away from the light for more than six months, under a bell-jar, with sulphuric acid, was fused and kept in this state in a current of air deprived of organic matter until its weight was constant.

The second series was made with the nitrate of silver described under No. VI. of the Table of the synthesis of this salt (CHEMICAL NEWS, Vol. IV. p. 244).

For the third series I employed a new nitrate of silver, obtained by dissolving in nitric acid the silver produced by the electrolysis of argento-cyanide of potassium. The salt was fused and dried as in the synthesis of the nitrate. The chloride of potassium employed was a portion of the same body which had served to establish the comparison with silver.

The nitrate of silver of the three experiments was white, lamellar, and of a pearly lustre. Its solution was neutral to test-paper. Before being weighed it was broken into small fragments, then heated in a platinum crucible, and introduced, as warm as possible, into the tube in which it was to be weighed after cooling. The tube was placed under a bell-jar with concentrated sulphuric acid. At each weighing of the nitrate I have stated the uncertainty which it presents. Nothing is easier than to get the weight of ten, twenty, or thirty grammes of chloride of potassium to almost the tenth of a milligramme; but, on account of the hygrometric property of nitrate of silver when fused and broken up into small fragments, I am not certain of the weight of an equal quantity of this salt to about one and a-half milligrammes. It was on this account that I determined to make a third series of experiments, weighing the broken-up nitrate of silver this time *in vacuo*, previously heated and then cooled likewise in a vacuum.

The weights of the nitrate and chloride were taken according to the relation deduced from Prout's law, taking for the equivalent of nitrate of silver 170, and that of chloride of potassium 74·5.

The nitrate was first introduced into a flask, and then dissolved in thirty-five times its weight of pure water, to ascertain its complete solubility.[1] The solution was mixed with four cubic centimètres of pure nitric acid per gramme of nitrate, and decomposed by the alkaline chloride. The operation was then concluded absolutely

[1] Nitrate of silver may contain traces of chloride and still produce a clear solution if dissolved in less than ten times its weight of water.

in the same manner as for the proportional relation between silver and the alkaline chlorides.

Proportional Relation between Nitrate of Silver and Chloride of Potassium.

Numerical Order.	Weight of the Chloride of Potassium in air.	Weight of the Chloride of Potassium reduced to a vacuum.	Weight of the Nitrate of Silver in air.	Weight of the Nitrate of Silver reduced to a vacuum.	Weight of the excess of Nitrate of Silver.	Weight of the corresponding Chloride of Potassium.	100·000 parts of Silver equivalent to Chloride of Potassium.
	First Series.						
	grms.	grms.	grms.	grms.	grms.	grms.	
I.	4·7218	4·72463	10·77850	10·78100	0·01323	0·00581	43·878
II.	5·1431	5·74618	11·74020	11·74295	0·01400	0·00615	43·875
III.	10·082	10·0862	23·0100	23·0155	0·02709	0·01190	43·875
IV.	15·3118	15·3210	34·9532	34·9614	0·04142	0·01817	43·874
						Mean ..	43·8755
	Second Series.						
V.	4·5159	4·5186	10·3086	1·3110	0·00963	0·00425	43·864
VI.	8·9457	8·9483	20·4140	20·4190	0·02126	0·009396	43·869
VII.	13·6931	13·7014	31·25/4	31·2650	0·03685	0·01600	44·876
						Mean ..	43·870
	Third Series.(2)						
VIII.	7·9796	7·9844	18·2210	18·2195	0·0162	0·0112	43·884
IX.	11·4234	11·4302	26·0855	26·0853	0·0223	0·0154	43 878
X.	12·5890	11·59655(3)	28·7440	28·7438	0·0256	0·0177	43·885
						Mean ..	43·885
						Mean ..	43·8758

(2) In the Third Series all the weighings were performed *in vacuo*.
(3) Thus in the original paper: evidently a misprint for 12·59655.

Determination of the Proportional Relation between Nitrate of Silver and Chloride of Ammonium.—I have sought for the proportional relation between these two bodies to control, at the same time, my syntheses of nitrate of silver and the relation which I found to exist between this metal and chloride of ammonium. I took for these determinations a portion of the nitrate of silver which served for the first two series of experiments with chloride of potassium.

I employed the sal-ammoniac of No. XI. for No. I.; of No. XII. for No. II.; and of Nos. XIII. for Nos. III. and IV.

Proportional Relation between Nitrate of Silver and Chloride of Ammonium:

Numerical Order.	Weight of the Chloride of Ammonium in air.	Weight of the Chloride of Ammonium reduced to a vacuum.	Weight of the Nitrate of Silver in air.	Weight of the Nitrate of Silver reduced to a vacuum.	Weight of the excess of Nitrate of Silver.	Weight of the Corresponding Chloride of Ammonium.	100·000 parts of Silver equivalent to Chloride of Ammonium.
	grms.	grms.	grms.	grms.	grms.	grms.	
I.	4·60790	4·61144	14·64974	14·65317	0·00898	0·00283	31·489
II.	6·9754	6·98077	22·1767	22·1819	0·01400	0·00440	31·490
III.	7·9061	7·91217	25·1372	25·1430	0·01496	0·00470	31·487
IV.	6·5788	6·5839	20·9171	20·9220	0·01230	0·00380	31·486
						Mean ..	31·488

(To be continued.)

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. Mulder, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page 232.*)

In both the experiments above mentioned,—viz., 1 gramme and 3 grammes silver, temperature 15° to 17° C., the quantities of 20 and 60 drops of the decimal solutions were respectively required in order to produce, just to the extreme limit thereof, the mutual precipitate. 20 drops are exactly contained in 1 cubic centimètre; hence what holds good for 1 gramme of silver holds good also for 1 milligramme of silver, or an equivalent quantity of common salt,—viz., 0·54 milligramme; for 3 grammes of silver it likewise holds good for 3 milligrammes of silver or 1·62 milligrammes of chloride of sodium. With these quantities, viz.:

1 milligramme of silver, 3 milligrammes of silver,
or 0·54 milligramme of salt or 1·62 milligrammes of salt

are equivalent:

1·33 milligrammes ClAg; 3·99 milligrammes ClAg;

These, to be sure, are quantities which may even be of some consideration in the practice, while as far as pure science is concerned, it is the indication of the measure of that quantity, which gets withdrawn from the precipitation.

We will now see more about the solubility of chloride of silver in solution of nitrate of soda. We have already seen that, at least at higher temperature, this solubility of chloride of silver in nitrate of soda does really exist. If we are forced to assume that, according to what we have already learned, the solution, whether brought to the neutral point, or above, or below it, contains,—

$$\begin{matrix} NO_5AgO \\ ClNa, \end{matrix}$$

then the whole matter is elucidated, provided the solubility of chloride of silver in nitrate of soda be proved at the same time, for nobody can practically demonstrate a difference between

$$\begin{matrix} NO_5,NaO \\ ClAg \end{matrix} \quad \text{and} \quad \begin{matrix} NO_5,AgO \\ ClNa \end{matrix}$$

It is first to be seen to what amount the solubility of chloride of silver in nitrate of soda ought to go in order properly to account for the phenomenon.

1 milligramme of silver yields 1·33 milligramme of chloride of silver. 0·541 gramme chloride of sodium in 100 cubic centimètres of the standard solution, yield 0·787 grammes nitrate of soda dissolved in 100 cubic centimètres of water. Under the circumstances just mentioned, 0·787 milligramme of nitrate of soda dissolve 1·33 milligramme of chloride of silver, or 592 parts of nitrate of soda 1 part of chloride of silver.

If chloride of silver, at a temperature of from 15° to 17° C., is to such an extent soluble in solution of nitrate of soda, then the whole phenomenon must be referred to solution,—viz., in the sense defined by Berthollet.

This solubility of chloride of silver in nitrate of soda was rendered more evident by the following experiments, which also were made to illustrate the practical bearing of the phenomenon here spoken of:—

1. One gramme of pure silver was dissolved in 5 cubic centimètres of nitric acid, and afterwards just brought

to the utmost limit of precipitation, first by means of 100 cubic centimètres of the standard solution, and then a few drops of the decimal solution of salt. The temperature was 17° to 18° C. After this 22 drops of decimal solution of silver, and again 22 drops of decimal solution of salt were needed in order to precipitate every time unto the limit.

II. The same experiment as that just mentioned was made at the same time with 1 gramme of pure silver also, but to the solution of silver were added 2 grammes of pure crystallised nitrate of soda, 100 cubic centimètres of the standard solution, and a few drops of the decimal solution of salt produced the precipitate to the utmost limit. When, now, immediately afterwards, the decimal solution of silver and salt were added in every case to the limit of perceptible precipitate, then with silver again, and again salt, the drops being added two by two, the following result was obtained :—

Silver.	Salt.
A 38	B 38
C 38	D 38

Instead of 1·1 cubic centimètres or 22 drops, as in Experiment I., there was required 1·9 cubic centimètres of the solutions of silver and salt in order to produce the precipitate to the limit. From the common salt contained in 100 cubic centimètres of the standard solution, 0·787 grammes nitrate of soda is made by its reaction upon the nitric acid of the nitrate of silver. In every ordinary assay, therefore, that quantity of nitrate of soda is present.

In Experiment II. 2 grammes of nitrate of soda had been added, so that with the 0·787 gramme formed during the assay, 2·787 grammes were present. If we wish to assume the solubility of chloride of silver in nitrate of soda, we are already previously informed that in an ordinary assay 1 part of chloride of silver is soluble in 592 parts of nitrate of soda dissolved in 100 cubic centimètres of water. Experiment II. taught us that 2·787 grammes of nitrate of soda dissolve 1·9 milligramme of silver, equal to 2·527 milligrammes of chloride of silver, —*i. e.*, 1 part of chloride of silver finds 1103 parts of nitrate of soda dissolved in 100 cubic centimètres of water.

There remains now to inquire what effect water alone has in dissolving chloride of silver. In order to elucidate this, two experiments were made at the same time and under fully the same circumstances, the only difference being that 100 cubic centimètres of pure water were mixed with the solution of silver, which contained 1 gramme of pure silver. The solution to which water had been added required 5 drops more of the decimal solution of salt than the solution prepared without this extra addition.

In this experiment, made at 16·5° C., we see that the water alone, which dilutes the nitrate of soda, increases the solubility of the chloride of silver in the former salt. On applying the decimal solution of silver, in order to bring the solution last mentioned just to the limit of precipitability, but no further, I found that 29 drops were required for the solution to which 100 cubic centimètres of water had been added, while the other only required 20 drops. The difference of nine drops, expressed in silver, is 0·45 milligrammes,—*i. e.* 0·6 milligramme more of chloride of silver had been dissolved by 100 cubic centimètres of water.[1] From these particulars, in connection with those previously stated, it follows :—

1st. That it is in fact the nitrate of soda which gives rise to the production of the mutual precipitate of silver and salt.

2nd. That when the quantity of nitrate of soda is increased in the solution, the quantity of dissolved chloride of silver is also increased.

3rd. That the quantity of water present at the same time has an influence as well as the quantity of nitrate of soda.

I have, in speaking of this phenomenon, used the expression "solution of chloride of silver in nitrate of soda." It will hardly be necessary to remind the reader that this is precisely an instance of what has been more clearly indicated by Berthollet. What takes place in the experiments for the assay of silver on a smaller scale, finds place on a larger scale when, for instance, sulphate of potassa and chloride of calcium, both in solution, are mixed. Then there is formed chloride of potassium and sulphate of lime; but the sulphate actually precipitated is far less in quantity, than what has been formed in reality. We will keep, for simplicity's sake, the word "solution," the true signification of which we have given in the earlier pages of this treatise.

I subjoin the quantities of chloride of silver in relation to the solvent proportions of salt and water, as found by experiments; temperature 15° to 17° C. :—

Soluble Chloride of Silver. Milligrammes.	Nitrate of Soda. Grammes.	Water. Cubic centimètres.
1·33	0·787	100
1·93	0·787	200
3·99	2·361	300
2·53	2·787	100

The first of the above series of figures also refers to the quantities of chloride of silver, which may be precipitated by either solution of chloride of sodium, or nitrate of silver, both in equivalent proportions to each other, and therefore also equivalent with the chloride of silver of the first column, from liquids of the same composition as referred to in the second and third columns above mentioned.

The solubility of chloride of silver in nitrate of soda is no more to be relied on as soon as the chloride of silver has been discoloured by the light, for then there has been set at liberty some chlorine; hence the quantity of silver required is larger than what is equivalent to the last-added quantity of salt; while, secondly, the solubility of that chloride of silver which turned violet is greatly decreased. In the liquid obtained by dissolving one gramme of pure silver, to which precisely enough solution of salt had been added, in order to be brought to the neutral point, I observed, after twenty-four hours, when the chloride of silver had become pretty violet, that 0·575 milligrammes of silver solution were required to neutralise the chlorine set free; while I also found that the quantities of decimal solution of silver and salt which are required to precipitate each other mutually at 17° C. to the utmost limit, decrease from 20 drops or 1 cubic centimètre, to 13 drops, or 0·65 cubic centimètre.

I do not doubt a single moment that chloride of silver (provided it be first decomposed by light as much as possible) is insoluble in nitrate of soda. The remarkable phenomenon bearing upon the assay of silver just brought under notice deserves to be considered also from other points of view.

(To be continued.)

[1] We see there is a difference of half a drop between 5 and 9; 5 must either be 4½, or 9 must be 10. From what has been already said, it is evident that the one must be just the double of the other.

TECHNICAL CHEMISTRY.

On the Carburation of Gas.

The following Report has been addressed to the Commissioners of Sewers of the City of London, by their Engineer, Mr. W. Haywood :—

"In pursuance of the resolution of the Court of the 23rd April last, I have directed an experiment with the view of testing the value of the application to the public lamps, of the process patented by the United Kingdom Carburating Gas Company.

"The patent of this Company is for placing near to the gas burners a receptacle containing coal naphtha, the gas passing through or over this takes up, and becomes enriched by the addition of the volatile hydrocarbons contained in the naphtha, and the illuminating power of the gas is thereby increased; the quality of the naphtha employed determines mainly the degree of illuminating power gained, and the chemical and photometrical experiments laid before me show that it varies from 25 per cent, to 77 per cent. (See Appendix.)

"The experiment being one in which the Gas Companies are much interested, I applied to the Chartered Company, who light Moorgate Street, suggesting their co-operation in conducting it with me; the suggestion was at once acceded to, and their Inspector, Mr. Johnson, was placed in communication with me for that purpose.

"Moorgate Street was selected as well adapted for the experiment, there being an equal number of lamps upon each side of the way, but one or two private lamps only in the street, and but few shops; the street is, therefore, after an early hour of the evening almost entirely without artificial light, excepting that which it derives from the public gaslights.

"The patentees stating that by the application of their process equal light would be given with half the ordinary consumption of gas, the burners were regulated accordingly.

"The lamps experimented upon were twelve in number, six upon the western side, which were fitted with the ordinary batswing burners, calculated to consume upon the average of the night 5 cubic feet of gas per hour, and six upon the eastern side, fitted with batswing burners, calculated to consume $2\frac{1}{2}$ cubic feet per hour. The latter burners having attached to them the carburating apparatus of the Company, each of the twelve burners had a meter attached to it, to ascertain the actual consumption. No pressure regulators were fixed upon the lamps.

"The registration commenced upon the 19th of June, and terminated upon the 19th of July inst., the experiment extending therefore over thirty nights, and gave the following results.

"That the burners without the carburating apparatus consumed about 4·39 cubic feet per hour.

"That the burners fitted up with the carburating apparatus consumed 2·09 cubic feet per hour.

"No photometer was employed, the equalisation of the amount of light given by the two classes of burners was a matter of judgment. The District Inspector of the Commission, who saw the lights nightly, reports his opinion that the light given was perfectly equal, and that his opinion is strengthened by collecting those of certain residents in the neighbourhood. My own opinion is that the light of the $2\frac{1}{2}$ feet burners was upon the average of the month inferior, although but very slightly so, to that of the 5 feet burners. The Inspector of the Chartered Company coincides with me in this.

"No chemical analysis was made of the naphtha used; but it is stated by the patentees to have been of the best quality.

"My deduction from the experiment is, that with naphtha of equal quality to that used, that during the warm months of the year 3 cubic feet of carburated gas may be considered as about equal to 5 cubic feet of gas not carburated.

"Assuming this to be data applicable to all seasons of the year, I have estimated the saving to be effected by the process, and, after allowing for the cost of the apparatus, and for periodically filling it with naphtha, and, after giving credit at the present price of the gas supplied to the public lamps for the quantity not consumed, it shows that the reduction in the cost of each public lamp will be at least 1*l.* per annum; and there being 2825 lamps within the City, that a saving of 2825*l.* would be annually effected.

"The only disadvantage observed during the experiment was that the reservoir, as constructed, throws a disk of shadow round the base of the gas lamp standard, but the depth of shadow is but slight; this disadvantage may be largely rectified by an alteration in the form of apparatus.

"It should be understood that I do not pledge myself to any of these figures as exact, for the experiment as conducted cannot lay claim to be considered minute or exact in its character; but I believe it may, nevertheless, be taken as giving a close approximation to the truth; it is the mean of the rough results of practice, and the refined processes of the laboratory from which reliable data are generally drawn; in this case the results of the experiment are supported by laboratory experiments, and consequently there seems but little doubt that this mode of applying naphtha to the public lights (for the naphthalisation of gas itself is by no means new) may lead to a considerable reduction in the cost of public lighting; but what that reduction ultimately would be, would depend upon points which can only be determined by the application of the process to a considerable number of lamps for some length of time, and at different seasons."

The following is Dr. Letheby's Appendix to the above Report :—

"The apparatus consists of a chamber for holding coal naphtha, and of a contrivance for directing the stream of gas over the surface of the naphtha. By this means the gas becomes charged with volatile hydrocarbons, and acquires a higher illuminating power.

"Three sets of experiments were made for the purpose of determining the value of the apparatus. In the first set a naphtha rich in benzole was employed, and the results were, that at first it raised the illuminating power of ordinary twelve-candle gas to twenty-four candles, and in the course of three days the power fell to eighteen candles, the mean of the whole being twenty-one candles. This is an increase of 77 per cent., and it was effected by giving 10·77 grains of naphtha to each cubic foot of gas.

"In both of the other sets of experiments an inferior kind of naphtha was used, and in one case the average increase of illuminating power, during a period of ten days, and after the passage of a thousand cubic feet of gas, was 25 per cent. In the other case, after a duration of five days, the average increase was 30 per cent. The former was effected by the addition of four grains of

naphtha vapour to each cubic foot of gas, and the latter by 6·56 grains.

"These data are sufficient to indicate the general capabilities of the apparatus; for they show that with a good naphtha, supplied in proper quantity, and furnishing from ten to eleven grains of vapour to each cubic foot of gas, the illuminating power of an inferior gas may be nearly doubled. A less volatile naphtha, giving only from four to seven grains of vapour per cubic foot, will increase the power of twelve-candle gas from 25 to 30 per cent. I am, therefore, of opinion, that the apparatus is of practical value as a carburetting agent, and that if supplied with good naptha, in proper quantity, there will be no difficulty in sustaining a power of twenty candles with ordinary coal gas."

Upon receiving this Report and Appendix, the Commissioners of Sewers resolved that it should be referred to the Engineer and Medical Officer of Health, to consider the conditions of the contracts for public lighting; having special reference to the increased illuminating power of the gas to be supplied, and to the possibility of carburating the gas by the process of the Carburating Company.

These gentlemen, Dr. Letheby and Mr. Haywood, have now reported upon this subject in the following terms:—

"Before considering the general conditions of a contract, it is necessary firstly to obtain the determination of your honourable Board to the leading principles upon which the contract should be framed, and it is to those we now specially address ourselves.

"As regards that portion of the reference which relates to the possible reduction of the consumption of gas in the street lamps, we are of opinion that, if the carburating process is not applied, the increase of the illuminating power proposed by the Metropolis Gas Act of 1861, does not render it expedient to diminish the amount of gas to be supplied at the burners of the public lamps; and that the contract should therefore remain as heretofore in this respect, unless the Companies alter the quality of the present supply, and furnish Cannel gas to the public lamps, as the Act of Parliament empowers them to do: under which circumstances it will be necessary to readjust the contract and mode of supply accordingly.

"With regard to the carburating process, we are of opinion, from the data obtained by the laboratory experiments quoted in the report to the Commission of the 30th July last, and the experiments made on the public lamps in Moorgate Street, during the months of June and July last, that the process of carburation appears to be capable of economising the use of gas in the public lamps, to the extent of from 40 to 50 per cent. This conclusion is founded on the assumption that the best quality of naphtha is to be used, namely, a naphtha which will give to the gas continuously a proportion of about ten grains of volatile hydrocarbon to each cubic foot of gas: these being the average results of the laboratory experiments. If an inferior kind of naphtha be employed, the results will be less satisfactory; for the laboratory experiments show that a naphtha yielding four grains of volatile hydrocarbon will increase the illuminating power of the gas to only about from 15 to 20 per cent.

"It is manifest, therefore, that the practical efficacy of these results will be entirely dependent on the perfection of the apparatus and the quality of the naphtha, and we are of opinion that these essential conditions can only be secured during the earlier application of the process by an arrangement with the Carburating Company for the supply of the apparatus and the naphtha, as also for the maintenance of the same in complete working order, according to the terms of a contract founded on the preceding data, namely, that a burner consuming three feet of the naphthalised gas per hour shall give continuously the light of a burner consuming five feet per hour of the same gas not naphthalised; and to secure this, the naphtha should be of such quality as to furnish continuously not less than seven grains of volatile hydrocarbon to each cubic foot of the gas. If the Company is willing to undertake such a contract upon suitable terms, we see no difficulty in the practical application of the system.

"If these suggestions are adopted, it will be necessary to contract both with the Gas Companies and the Carburating Company; the terms of such contracts, which should have due relation to each other, must be a matter for future consideration."

PHARMACY, TOXICOLOGY, &c.

On Kerosolene, by Edward Parrish.

Some of the most useful scientific and practical discoveries have originated in accidents, the first results of which have involved disappointment or inconvenience. To evolve from these the lessons by which they may be made to subserve useful ends should be one of the chief aims of the experimentalist.

To the accidental anæsthetic effects produced upon a workman employed to clean a cistern in a kerosene oil works in Boston we owe the recent discovery of a new use for an abundant product of the destructive distillation of coal. This product, though heretofore procured in a crude condition at a certain stage of the process, in the works alluded to and perhaps in others, has not until recently been rectified and thrown into the market, because no demand existed for it for any known use of which it was capable.

With the enterprise so characteristic of New England character—a trait which so happily gave to science and humanity one of the greatest blessings of modern times—ether as an anæsthetic—the Boston physicians have taken measures to investigate the utility of this article for similar purposes, pending which it naturally claims the attention of pharmaceutists in its physical and chemical characters.

Two bottles of the liquid have been sent me, the first by a medical friend residing in Massachusetts, and the second, at my request, by the manufacturer, Joshua Merrill, superintendent of the Downer Kerosene Oil Company, from whom I learn that kerosolene, as it is named, is a product of the destructive distillation of "Albert coal," at temperatures varying from 600° to 890° F. The very volatile portion, separated by careful fractional distillation from the more fixed products which are sold as kerosene, is purified so as to remove its unpleasant odour, and thoroughly rectified.

As thus produced, kerosolene is a tasteless, colourless, though highly refractive, inflammable liquid, burning with a bright smoky flame. It is very mobile and volatile, and the bead disappears immediately. A vial, when grasped by the palm of the hand, gives off small bubbles of vapour, raising the stopper. Its odour is very faint, reminding of chloroform at first, though less

agreeable as it evaporates, leaving not the slightest odour when it dries. Its sp. gr. varied in the two specimens at first received, that of No. 1 being ·6346 at 76° F., of No. 2 ·6325 at 72° F.; but by exposure for two weeks in a partly filled tincture bottle, occasionally opened, the specimen marked No. 1 reached a sp. gr. of ·6420 at 72° F.

From the last named fact and its known origin and mode of preparation, it would be supposed that this liquid had not a uniform composition, but must be a mixture of different carbohydrogens of varying density and volatility. The truth of this was proved by the following experiments:—Specimen No. 1 was heated in a water bath, and its boiling points carefully noted. At 84° F. it commenced to boil, the temperature rapidly rising to 90°, and afterwards slowly, without becoming stationary, to 150°, when boiling ceased, about one-sixth of the original liquid remaining, which was evaporated at about 200° without boiling. Specimen No. 2 was subjected to similar experiments. It commenced to boil at 82° F., ceased at 94°, recommenced at 100°, and ceased at 105°, when the remainder, about two-thirds, was evaporated without boiling, at a temperature not exceeding 180°.

The extremely low sp. gr. of this substance and the temperature at which it begins to boil forbid the idea of its containing the ordinary coal tar products in considerable proportion. The light naphtha first obtained in the distillation of coal tar has a sp. gr., according to Mansfield, of ·900 to ·950, and when purified by agitation with sulphuric acid and potash, or by the process of Gregory, in which peroxide of manganese is used, and rectified, its density does not fall below that of benzine, the sp. gr. of which, in its liquid form, is variously stated at ·85 and ·8991, at different temperatures.

The largest proportion of kerosolene is evidently composed of those very light carbohydrogens not present in coal tar, and not produced at the high temperatures employed in the production of illuminating gas.

In the books I have consulted I find no detailed account of these almost gaseous liquids, and I can imagine no subject presenting more difficulties to the chemist. Professor Antisell, in his thoroughly practical work on Photogenic and Hydrocarbon Oils, remarks that "the specific gravity and chemical constitution of the light and heavy oils vary in relation to the temperature at which they are distilled; and perhaps no two distillations give exactly the same relative mixture of the various hydrocarbons of which they are composed." The composition of these is further varied by the nature of the crude materials, which may be highly bituminous, like the "Albert coal," from which the specimens under consideration were obtained, or more completely formed coals like the more common varieties.

The proportion of matter volatile at redness in the "Albert coal" has been stated at 61·74 per cent., that of the "Breckenridge coal," of Kentucky, at 60·27 per cent., while Pittsburg coal yields but 32·95 per cent.

Chemists have obtained from coal tar by fractional distillation several substances of great utility. Of these benzine or benzol $C_{12}H_6$, which, as before stated, is the chief constituent of the light naphtha, is also a constituent of kerosolene, as ascertained by testing it with nitric acid, which developed the odour of nitrobenzol. The chief constituents of the photogenic liquids as thrown into commerce under the name of coal oils or kerosolene, are toluol $C_{14}H_8$, which has a sp. gr. of ·870 and boiling point 237° F. (Gerhardt 230), and Cumol $C_{18}H_{12}$, which is also lighter than water, and boils at 314°. It is not improbable that traces of these may be present in the new liquid, though they vary from it so much both in sp. gr. and boiling point. Experiments to detect aniline $C_{12}H_7N$ in the specimens under examination failed to indicate it as might be anticipated, its sp. gr. being stated at 1·020, and the process of rectification with sulphuric acid being adapted to separate any alkaloids if originally present.

Compared with the commercial article of benzol, now so extensively sold, kerosolene presents several marked points of difference. Three specimens of benzol I have examined have respectively, at 60° F., the sp. gr. ·7521, ·7661, and ·8708. These differ in sensible properties from each other almost as much as they do from kerosolene. The most agreeable in odour I imported from England at a much higher price than that paid for the American varieties, which I have generally found disagreeably "balsamic," sometimes resembling impure illuminating gas, and leading to the belief that the gas was escaping into the room. One specimen became almost intolerable by age, while the colour became gradually yellow. Kerosolene, as before stated, is almost free from odour; it is so very mobile, light, and colourless that it could not be mistaken for benzol, and still less for kerosene, its properties having relation to the latter substance not unlike those of ether to oil of turpentine.

Under the name of Eupion chemists formerly described a product of the destructive distillation of wood, which was believed to be C_5H_6, but it has since been shown by Voelckel that the portions rising below 212° F. consisted chiefly of acetate of methyl with acetone, a little benzol, xylite, and mesite.

The sp. gr. of eupion was stated at ·655, its boiling point at 118° F., rising as high as 336° in some samples. Though stated to be the lightest of known substances, it will be seen that this product was rather more dense than our new carbohydrogen product. Accounts differed in regard to its miscibility with water and alcohol. It was, however, described as freely miscible with ether and oils, and as being of a faint and agreeable odour and without taste, which properties correspond with those of the liquor under consideration. That kerosolene contains no more than a slight trace of any oxygenated body was shown by immersing sodium in it, a fresh surface of the metal was only slightly tarnished by the contact.

The solvent properties of this new substance are of course of primary importance. They appear to me to present the true key to its usefulness. It dissolves fixed oils, apparently, in all proportions, common resin freely, though with flocculent residue, wax and cocoa-butter freely, mastic and caoutchouc slightly. It mixes freely with alcohol, oil of turpentine, ether, and chloroform, but not with water. Iodine dissolves in it sparingly, yielding a remarkably rich, though changing, purple colour.

For the common uses to which benzol is now applied, kerosolene appears to be equally adapted. By the absence of disagreeable odour it is rendered generally preferable. It is, however, unsuited to the purposes of illumination, or to generating heat, being too volatile, though its vapour does not appear to be explosive. Its extreme volatility makes it important that it should be excluded from the kerosene or other photogenic oils, and renders it a residuary product, heretofore without value, of those works in which it has been produced in a crude condition.

How far this product could be furnished by the manu-

facturers, of uniform quality, or whether it could be produced at other kerosene works, and by those numerous establishments in which the so-called rock oils now pumped in such vast quantities in the western slopes of the Alleghanies, are rectified, is a practical question yet to be tested. Its relations are evidently to this class of bitumens rather than to coal tar.

In view of its use in medicine, the fact of the great uncertainty of its composition, its being a mixture of different and undetermined proximate constituents, must interfere with its general adoption and recognition.—*American Journal of Pharmacy.*

On the Preparation of a Natural Iodine Wine, by Dr. BOINET.

ORIGINALLY administered in the natural state and dissolved in water by Coindet, iodine has been exhibited much more efficaciously through the intervention of iodide of potassium, as recommended by Dr. Lugol. This latter salt, indeed, has been almost completely substituted for it, and it is nearly exclusively in this form that internal treatment with iodine is effected.

Reason, however, points out that advantage is gained in giving medicaments in a state as nearly as possible like that in which they are found in nature; and, indeed, iodide of potassium, on account of the special action which it exerts on the mucous membranes of the eye, nose, and larynx, offers real inconveniences, and is impossible to be taken by some persons.

Under these circumstances, M. Debauque has opened a way which promises to be of service in showing how to render iodine soluble in tannin without the aid of iodide of potassium. From this has arisen M. Boinet's idea of administering iodine in liquids or syrups containing tannic acid, such as the wines of horse-radish, quinine, gentian, walnut, or orange peel.

Arguing upon the good results effected by iodine contained in mineral waters, certain salts and plants, and burnt sponge, although these only contain very small quantities, remembering the results which he had already obtained by the incorporation of this metalloid into articles of food (iodised alimentation); and, as he has repeatedly said, to get farther from the laboratory and nearer to nature, M. Boinet has been induced to search for a preparation of this kind which would not have upon the tongue, the throat, nor the stomach, the ill effects of ordinary iodine wines, which are usually prepared by the addition of tincture of iodine or iodine of potassium. This is what he does:—

At the time of vintage commence by picking the grapes so as only to have them ripe and fit to make good wine. They must not be picked off the bunch, on account of the tannin and salts contained by the stalk, which serve to preserve the wine and aid fermentation. They are placed in a large wooden tub capable of holding many barrels of wine. At the bottom is placed a thick layer of grapes, then above a layer of powdered seaweed, or even a layer of ashes of these plants; then a fresh layer of grapes, then another layer of sea-weed, and so on, until the tub is full. The whole is then covered with a layer of chopped straw to keep the air away and favour fermentation. The important operation of working now commences, which lasts from fifteen to twenty days, according to the temperature. When the wine is fit to draw off—that is to say, when the fermentation is complete and the grape sugar changed into alcohol and carbonic acid, and it has dissolved and assimilated to itself the iodine contained in the weeds—it is placed in casks, keeping it as much as possible from contact with the air. To effect this, it must be drawn from the tub by means of a tap. The concluding operations are effected as with ordinary wine. This wine is, however, nothing more than a tincture of iodine, obtained like other tinctures, as that of aloes, opium, &c., by maceration and fermentation.

This wine M. Boinet calls natural iodine wine. It keeps as well as ordinary wine, and has not, like syrups, the inconvenience of fermenting and decomposing. It contains so much iodine that it can even be mixed with other wine before being administered. The dose may be two or three spoonfuls unmixed per day for adults, and the same in coffee for children. M. Boinet usually administers it in the following manner:—In the wine usually drank at meals, or in any other beverage, a spoonful of this iodine wine is mixed at each meal. This wine has no disagreeable taste, and were invalids not told of it, they would not suspect that they were taking iodine or wine containing iodine.—*Bull. de Thérap.*

PHYSICAL SCIENCE.

On Spectrum Analysis, by M. MORREN. *(Extract from a letter to the Abbé Moigno, Editor of "Cosmos.")*

WHILST I fully appreciate the beautiful researches of MM. Bunsen and Kirchhoff, I cannot but feel that their conclusions in respect to the constitution of the solar photosphere are somewhat premature and hasty. I will, in the first place, state that the yellow ray D, which is used as an argument in favour of admitting sodium as a constituent of the photosphere will prove as much for many other bodies. I might name several, but will confine myself to iron and mercury. This latter metal gives the yellow ray D, double and in a marvellous manner, together with the most beautiful violet ray that can be imagined. Another thing which ought to make us speak with extreme reserve is, that we have as yet only very incomplete knowledge of the spectra of metals. Some eminent physicists (I mention those quoted by the Heidelberg savans), MM. Van der Willigen, Masson, and Angström, have only seen an inconsiderable number of rays belonging to many metals, especially iron; and this may be perfectly imagined at the present time, for, indeed, in the voltaic are produced by the battery many parts must be distinguished.

1. An incandescent, very luminous portion formed of the electrodes, of dazzling lustre if they are of carbon, and fused if they are metallic. This portion only furnishes a very brilliant, continuous spectrum, free from lines.

2. The gaseous aureola, which in a powerful battery is very large, and which alone yields rays. This aureola, when the electrodes are of carbon, is formed, as is known, of two oval, concentric parts, the one violet in the centre, and the other orange throughout. It is reasonable to suppose that each of these has its distinct lines, and that the surrounding medium may also play some part in it. It is, moreover, certain that those physicists who, for want of a sufficiently powerful battery, have experimented with the electrodes too near together, have only been able to see a very limited number of brilliant rays; being overpowered by the presence of the continuous spectrum, dazzling and free from rays, formed by the incandescent liquid or solid portion of the electrodes. Hence all these differences. This week I have been

working with a battery of 65 Bunsen's elements, large size, and I have obtained with iron an admirable aureola, in each part of which, even in a very small space, the rays were in excessive number. With a powerful magnifying apparatus, I have seen skilful persons unable to count them in the field of the telescope without great difficulty. In the presence of rays so close together and so little known, it is difficult to establish without error unexceptionable coincidences.

I think, therefore, that before affirming that such or such a metal produced the negative spectrum of the sun by its presence in the photosphere, we should be perfectly acquainted with the spectra of metals, gases, and all bodies; whereas we have at present but the rough outline of such a work which is called for by the state of science. It is to be desired that these important spectra should be made with extreme care, under the control of the several savans who have studied this branch of physics, and especially under perfect and comparable conditions. Having drawn such spectra, I know how delicate and difficult is such a work; the most skilful at it are liable to error. For instance, I will mention to MM. Bunsen and Kirchhoff the extreme red ray of potassium. These gentlemen have said that it exactly corresponds to the solar line A. That is not so. The red ray of potassium is remarkable in that it is so much less refrangible than the line A of the solar spectrum that it is difficult to see, when no other precautions are taken to see it than those which suffice to illuminate and show in their beauty all the red rays of solar light. Owing to the length of this letter, I must defer entering upon details until another occasion. The red ray of potassium is at this moment the least refrangible ray of light known. I have, besides, made this experiment for the first time in the presence of M. Plucker. We first placed the micrometer wire over the solar line A; then, without touching the apparatus we observed in it the red ray of potassium. Having measured this, we returned once more to the ray A. The difference of minimum deviation between these two rays is at least 20′.

P.S.—Later researches enable me to state that the blue part of the flame of the candle, alcohol, lighting gas, paper, &c., is due to the combustion of *protocarburetted hydrogen*, and not of *oxide of carbon*, as has been hitherto supposed, and as I myself have stated before. Spectral analysis proves this in an incontestible manner.

On the Blue Band of the Lithium Spectrum,[1] *by Professor* Frankland, *F.R.S.*

On throwing the spectrum of lithium upon the screen yesterday I was surprised to see a magnificent blue band. At first I thought the chloride of lithium must be adulterated with strontium, but on testing it with Steinheil's apparatus it yielded normal results without any trace of blue band. I am just now reading the report of your discourse in the Chemical News, and I find that you have noticed the same thing. Whence does this blue line arise? Does it really belong to the lithium, or are the coke points or ignited air guilty of its production? I find three blue bands with chloride of sodium, but they have not the definiteness and brilliancy of the lithium band. When lithium wire burns in the air it emits a splendid crimson light; plunge it into oxygen and the light changes to bluish-white. This seems to indicate that a high temperature is necessary to bring out the blue ray.

P.S.—I have just made some further experiments on the lithium spectrum, and they conclusively prove that the appearance of the blue line entirely depends upon temperature. The spectrum of chloride of lithium ignited in a Bunsen's burner-flame does not disclose the faintest trace of the blue line. Replace the Bunsen's burner by a jet of hydrogen—the temperature of which is higher than that of the Bunsen's burner—and the blue line appears, faint, it is true, but sharp and quite unmistakeable. If oxygen be now slowly turned into the jet, the brilliancy of the blue line increases until the temperature of the flame rises high enough to fuse the platinum, and thus puts an end to the experiment.

Note by Dr. Tyndall.

[On the occasion referred to by Dr. Frankland, it was a general impression among the chemists present at the lecture that I had used the word lithium for strontium throughout the evening. This induced me to ask Dr. Miller to test my chloride of lithium, which he found quite pure. I afterwards showed the blue band, the splendour of which is unrivalled, to my class at the School of Mines. The coal points without the lithium show nothing of the kind; with the lithium the band always appears. Either, therefore, the substance itself is so altered by the exalted temperature that new periods of oscillation are possible to it, or the medium in which it vibrates is so changed in elasticity as to permit of the same thing. The observation appears to be one of considerable significance. I would also draw attention to the experiment by which the absorption of the yellow band by the sodium flame was effected on the same occasion as one of the most striking class experiments in the whole range of optics. It is very easily performed, a band 18 inches long and three-quarters of an inch wide being quite attainable within ordinary lecture-room limits. A salt flame 10 feet thick produced no such effect. Dr. Miller, I am informed, repeated this experiment with success before an evening meeting of the British Association at Manchester.]

[1] In a letter from Professor Frankland to Dr. Tyndall, published in the last number of the *Philosophical Magazine*.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY OF DUBLIN.

Monday, November 25, 1861.

The Honourable J. P. Vereker, *F.R.S., President, in the Chair.*

The minutes of the former meeting having been read and confirmed, the President called on Professor C. A. Cameron, M.D., M.R.I.A., to deliver a discourse "*On Bünsen and Kirchhoff's Method of Spectrum Analysis.*"

Dr. Cameron commenced by observing that he was induced to bring the subject before the Society by the consideration that it has not, up to the present time, been brought publicly under the notice of any of the learned Societies in Ireland, although this has frequently been done on the other side of the Channel. He then made some observations on the nature of light, and the mode of forming the solar prismatic spectrum. He pointed out the dark spaces termed "Fraunhofer's lines" in the spectrum, and demonstrated the coincidence of these with the luminous bands observable in the spectra of certain of the metals, and, likewise, how they were caused by what might be termed a negative spectrum of the luminous envelope of the sun. He then exhibited the spectra

produced by burning salts of sodium, potassium, calcium, &c., and explained the method of using the spectroscope, which, in this instance, was the form of apparatus described by Mr. Crookes, and supplied by Spencer Browning and Co. Dr. Cameron showed that, by means of this instrument, the presence of inconceivably small quantities could be easily and expeditiously detected. Thus it was found that soda was almost always present in the atmosphere, and that the metal lithium, hitherto supposed to be found only in a few rare minerals, such as Killinite (found at Killiney Hill), was universally diffused; and also, by its means, three new elementary bodies have been discovered, two by MM. Bünsen and Kirchhoff, and one by Mr. Crookes. The discourse was illustrated by diagrams and numerous experiments, and at its close there was warm applause.

A paper was then read by Mr. Emerson Reynolds, Assistant-Chemist to the Society, "*On a New Process for Photographic Printing.*" The author commenced by apologising for bringing a photographic subject before the Society at all. He said that he would not have done so, only that his process was intimately connected with a subject which he would have the honour of communicating at the next meeting of the Society. Mr. Reynolds then went on to say that in the early part of last year accident had led him to the study of some of the compounds of oxalic acid with the oxides of iron, and, while pursuing his investigations, he had observed a peculiar decomposition to take place under the influence of the solar rays,—namely, the reduction of the peroxalate of iron to the state of protoxalate. At first he was under the impression that no one had noticed this fact before, but subsequently he ascertained that Dobereiner had pointed it out in the earlier part of the present century, however, no one thought of applying the reaction to photographic use. This he has done, and has been very successful in working out the subject. His process is substantially as follows:—Paper is saturated with a solution of ammonio ferric oxalate in the usual way, when dried in the dark, it is exposed under a negative, and after being sufficiently printed, is taken out of the pressure frame and thoroughly washed with water. The picture, which is now of a light yellow colour, is then immersed in a very dilute solution of ammonio-nitrate of silver, containing as little ammonia as possible, when it is immediately developed, and appears of a fine dark colour, all that now remains to be done, is to wash, dry, and mount, when the picture is finished. The author states that the whole process from the commencement of the printing till the picture is mounted, on a fine day, does not occupy more than two hours, in this time he has obtained pictures, which up to the present, have not faded in the least. Several specimens of the process were shown and were much admired by those present.

Mr. Charles R. C. Tichborne then read a paper "*On the Naphthaline Colours.*" This paper is supplementary to one, by the same author, which appeared in a late number of the Chemical News. Mr. Tichborne did not confine himself to his own experiments, but gave a general and very lucid description of the various products of the destructive distillation of coal. He explained the means which are adopted for purifying the crude naphthaline, and exhibited some beautifully crystallized specimens. He then proceeded to notice M. Roussin's paper on artificial alizarine, and produced some of that colouring matter by the action of a reducing agent on the binitro-naphthaline, and directed particular attention to the precautions to be observed so as to obtain the largest yield of the dye. The author then went on to say that it is from madder we get the colours known as Adrianople or Turkey red, which is the most durable vegetable tint known. The discovery is traceable to India. The process was afterwards practised in Asia and Greece, and, about the middle of the last century, works were established near Rouen. In 1765 the French Government caused an account of it to be published. Its introduction into England, at the end of the eighteenth century, was by a Manchester house, but the proper method of treating it was made known by a Frenchman (Papillon), who brought it into Glasgow. This latter town is still celebrated for this class of dyeing. Mr. Tichborne then went on to show the very close connexion which exists as regards physical and chemical propertics between alizarine—the most important tinctorial principle of madder—and the colouring matter produced by the action of reducing agents on binitro-naphthaline, although their identity in chemical constitution was not proved; for, as yet, no analyses have been made of the dye. Attention was then directed to the formation of a blue colour by means of cyanide of potassium, which the author has found may be converted into a beautiful green tint by the addition of some di-nitraniline. Dinitraphenic acid and the other yellow tar-products are not applicable. He concluded by exhibiting a number of specimens of ribbon and woollen fabrics which he had dyed with these colours, and are likely to prove most formidable rivals to the aniline compounds.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, December 2, 1861.

William Pole, *Esq., M.A., F.R.S., Treasurer and Vice-President, in the Chair.*

James Bass, Esq., Rev. George Bowes Macilwain, B.A., and David Ricardo, Esq., were elected Members of the Royal Institution.

NOTICES OF BOOKS.

A Manual of Chemistry, Descriptive and Theoretical. By William Odling, M.B., F.R.S. Part I. London: Longman and Co. 1861.

THIRD NOTICE.

Among carbon compounds we may cite the following as examples of heterologous series, taking the homologues methylene and ethylene as starting-points:—

Methylene . .	CH_2.	Ethylene . .	C_2H_4.
Formic aldehyde	CH_2O.	Aldehyde . .	C_2H_4O.
Formic acid. .	CH_2O_2.	Acetic acid . .	$C_2H_4O_2$.
Carbonic acid .	CH_2O_3.	Glycolic acid :	$C_2H_4O_3$.
		Glyoxylic acid.	$C_2H_4O_4$.

Professor Odling makes frequent use throughout the volume of tabular statements, which present at once, to any one capable of reading chemical formulæ, the clearest view of the relations between the bodies cited, and express in a few lines what would require a page or more to explain in words. Not only do these tables include numerous examples of homologous, isologous, and heterologous series, but our author arranges in like manner the various combinations of the same radicle. The following illustration refers to peroxide of hydrogen, the eurhyzene of Laurent:—

"The compound radicle, peroxide of hydrogen, HO, is equivalent to the simple radicle, chlorine, Cl, and in a great number of reactions is exchangeable for chlorine and its congeners. One of the most generally useful modes of oxygenating different compounds consists in first substituting a halogen in exchange for hydrogen, and then, by means of water, substituting peroxide of hydrogen in exchange for the halogen. Thus, by the action of bromine upon acetic acid, we obtain bromacetic acid:

$$C_2H_4O_2 + Br_2 = C_2H_3BrO_2 + HBr.$$

Then by the action of water upon bromacetic acid we obtain glycolic or oxyacetic acid:

$C_2H_3BrO_2 + H.HO = C_2H_3(HO)O_2$, or, $C_2H_4O_3 + HBr$.

It is observable that water may be regarded as a derivative of chlorhydric acid, in which the compound radicle HO replaces the simple radicle Cl, and so in other instances, thus:

Chlorhydric acid	H.Cl	H.HO	Water
Chlorine	Cl.Cl	HO.HO	Perox. of hyd.
Chloride of ethyle	C_2H_5.Cl	C_2H_5.HO	Alcohol
Chld. of benzoyle	C_7H_5O.Cl	C_7H_5O.HO	Benzoic acid
Chld. of sulphuryle	SO''_2.Cl_2	SO''_2.$(HO)_2$	Sulphuric acid
Chld. of phosphoryle	PO'''.Cl_3	PO'''.$(HO)_3$	Phos. acid."

An excellent table of the sulphates, showing the anhydrous sulphates and those containing various amounts of water of crystallization, will be found on page 176.

In the accounts of the oxides and hydrates, which is altogether thoroughly well-written and full of interesting matter, the reader will find the classification of the peroxides, and the relations of the oxides to the hydrates and the acids described with greater completeness than elsewhere.

The author has avoided a fault into which some advocates of the Unitary Notation repeatedly fall. It is very well to insist on the fact that formulæ do not necessarily indicate the constitution or building up of the substances to which they have been assigned, but that they chiefly serve to show the atomic relations of the constituent elements; yet the connection of one compound with another is lost sight of by the student whose teacher ignores compound radicles, and jots down before his class the formula of sulphuric acid sometimes as H_2SO_4, sometimes as SH_2O_4, and occasionally goes so far as to break it up, in a playful but not instructive manner, into as many pieces as possible. Those who have just liberated themselves from the traditions of the older chemical theories, should take care that their very liberality does not degenerate into dogmatism, for it must not be affirmed that the Unitary System is itself already perfect, and cannot admit of further development.

Dr. Odling discourses with ease and confidence in these pages, and not infrequently with a clearness and force that are truly admirable. He has shown, in many directions, the advantages accruing from the new system; and it is with pleasure rather than disappointment, that we see how, here and there, he expresses a doubt about the correctness of some of the views which he holds. We cannot help feeling sorry that Professor Odling has banished so completely from the volume before us, the great chemists, the results of whose labours are there collected and arranged. The student should occasionally be reminded of the careful and exact Berzelius, the brilliant Davy, the sagacious Dalton, and a few other illustrious names. Even Laurent and Gerhardt, the author's immediate teachers, scarcely get due credit in the body of the work itself, and a young reader might come to the conclusion—a conclusion which Professor Odling would be the last to encourage—that the author himself was the chemist of chemists. We also miss a clear, compact account of the grounds on which the change of systems is based. But the author continually shows a peculiar power of appreciating the bearings and relations of chemical facts discovered by others, and the task which he has undertaken is one for which he is well fitted. We have derived so much pleasure from examining Part I. of this work, that we wait anxiously for Part II.

NOTICES OF PATENTS.

Grants of Provisional Protection for Six Months.

2407. Joseph Tessier, Rue de St. Nicolas d'Antin, Paris, "Improved means of treating barley, corn, and other cereals, for brewing and other purposes."—Petition recorded September 26, 1861.

2574. Thomas Forster, Sparrow Hall, Streatham, Surrey, "Improvements in reworking waste vulcanised india-rubber."—Petition recorded October 16, 1861.

2692. Charles Stevens, Charing Cross, London, "Improved apparatuses for indicating escapes of lighting gas from the conveying pipes, and determining the precise leaking places of the said pipes."—A communication from Charles Antoine Fournier, Paris.—Petitions recorded October 26, 1861.

2700. George Mowbray Gilbert, Albany Terrace, Britannia Square, Worcestershire, "Improvements in preparing blue colour and in apparatus for applying such colour to water."—Petitions recorded October 28, 1861.

2706. John Bibbington, Rochdale, Lancashire, "Improvements in machinery for breaking and crushing limestone and other hard substances."

2716. John Henry Johnson, Lincoln's Inn Fields, London, "Improvements in the preparation or treatment of skins and hides."—A communication from Dr. Friederich Knapp, Munich, Bavaria.—Petitions recorded October 29, 1861.

2718. Marc Antoine François Mennons, Rue de l'Echiquier, Paris, "An improved composition for igniting lucifer matches."—A communication from Messrs. Auguste Halinbourg and Léopold Ber, Faubourg Poissonnière, Paris.

2739. William Clark, Chancery Lane London, "Improvements in photographic albums."—A communication from Claude Mamés Augustin Marion, Boulevart St. Martin, Paris.

2744. Robert Mushet, Coleford, Gloucestershire, "An improvement or improvements in the manufacture of cast steel or of homogeneous iron."

2754. John Charles Wilson, Bucklersbury, London, "Improvements in machinery or apparatus for the manufacture of sugar"

2761. George Evans, Gloucester Terrace, Portman Square, London, "Improvements in treating peat to render it useful as fuel and for illuminating and metallurgical purposes."

2764. Joseph Bowden, Hulme Street Works, Salford, Lancashire, "Certain improvements in dyeing and in apparatus employed in dyeing."

Notices to Proceed.

1706. Bevan George Sloper, Hackney, London, "An improved method of, and machinery for, amalgamating and for effecting the separation of gold from earthy and other matters containing the same."—Petition recorded July 4, 1861.

1732. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the manufacture of fluo-silicates and silicates of lead and baryta, and for the application of the same to various purposes in the arts and manufactures."—Petitions recorded July 8, 1861.

1733. Thomas Telford Macneill, Cockspur Street, London, "Improvements in the construction of barometers, and in apparatus for registering the indications of the same."

1734. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the treatment of silicates of metallic and non-metallic bases and other siliceous compounds of slags, scoriæ, and such like, in order to recover the said bases, and also in the production of fluo-silicic and silicic acids."

1756. Thomas John Smith, Queen Street, Cheapside, London, "Improvements in photographic albums."—Petition recorded July 12, 1861.

1772. Thomas Cobley, Meerholz, Hesse, Germany, "Improvements in the manufacture of metallic or earthy silicates or siliceous compounds of the same from the metallic and earthy bases or their salts and soluble alkaline

silicates, the formation of alkaline acetates or caustic alkalies, and application of the same."

1773. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for preserving indurated timber, wood, and other vegetable matters, and for rendering the same uninflammable."

1776. Thomas Cobley, Meerholz, Hesse, Germany, "An improved process for the production or manufacture of fluo-silicates of tin, zinc, and baryta, and their application as pigments for glazing, enamelling, and in the manufacture of glass."—Petitions recorded July 15, 1861.

2110. Richard Archibald Brooman, Fleet Street, London, "An improved method of treating the hop plant to obtain a material resembling wool."—A communication from Barthélemy Picard, Nancy, France.—Petition recorded August 23, 1861.

CORRESPONDENCE.

Fixing Colouring Matters.

To the Editor of the Chemical News.

Sir,—I observe, in No. 103 of your useful Journal, Notices of Patents taken for Fixing the Colouring Derivatives of Tar on Vegetable Fabrics, by Messrs. Miller, of Springfield, Glasgow, and by several others, all of which embody a common principle of fixing those colours by the formation of a tannate of tin from an alkaline stannate, in the fabrics—if we except that of Lloyd and Dale's, and of Church, who substitute antimony for tin—still retain the same principle.

I feel called, in duty to myself, and it may be the case with other practical men, to say, that ever since the introduction of mauve by Perkins, and of roseine by Simpson, I have followed the above plan, with considerable success.

I am, &c. John Hamilton.

Armitage Dye House, near Huddersfield.

Sparteine.

To the Editor of the Chemical News.

Sir,—Would you do me the favour of correcting an error in your last Number, contained in a report of the Proceedings of the Chemical Society? In a paper on Sparteine I am made to state that this base appears to be "homologous with nicotine." This was merely a suspicion, entertained prior to investigation,—at the end of which sparteine was found to be $C_{15}H_{26}N_2$. As nicotine is $C_{16}H_{14}N_2$, the bodies have, clearly, no relation of homology. The mistake is trifling enough in itself; but some of your readers might further imagine that it had been asserted in the original paper.—I am, &c.

Edmund J. Mills.

December 2.

On the Adulteration of Butter.

To the Editor of the Chemical News.

Sir,—It is not with any feelings of rivalry that I refer to the paper of Dr. Ballard in the last Number of the Chemical News, alluding to that of mine on the Adulteration of Butter, but, on a comparison of the two papers, it must be evident that the simplicity and practical utility of mine are not in the slightest degree diminished by the publication of the Doctor's.

Dr. Ballard takes objection to the other process on the score of expense. This is a matter of assumption merely, a teaspoonful or so of ether being ample for an experiment. Surely that quantity is not so expensive as to condemn its utility. More than that, I had a particular object in view in writing my paper—to show, in answer to a Correspondent, how easily lard—for that was the question—may be detected; and then I thought I might as well experiment on, and possibly include, other kinds of fat, which, I found, could all be readily identified thereby; but not so by the plan of Dr. Ballard, who considers "Beef Dripping" to be the general fatty adulterant used, which does not accord with my experience.—I am, &c.,

John Horsley, F.C.S.

The Laboratory, Police Station, Cheltenham.

MISCELLANEOUS.

Gas from Water.—Arrangements are being made, it is understood, at the Leeds Gasworks for the manufacture of gas from water, much on the principle carried out, some years ago, by Mr. White, in Manchester. Steam is decomposed in passing over incandescent coke or charcoal, and the liberated hydrogen is afterwards carburetted by being passed through resinous or other carbonising matter. —*Engineer.*

The Warmest and Best Clothing.—Most persons suppose that fabrics made of coarse wool are the warmest and most durable. This is a mistaken idea. Owing to the lower prices of coarse wool, fabrics of this material are usually made heavier than those of fine wool, hence their greater thickness deceive persons respecting their qualities for warmth and wear. There is no heat in the wool itself; its property of what is called "warmth" is due to its non-conducting qualities. If we grasp a bar of iron on a frosty morning it produces a disagreeable cold sensation because it is a good conductor of heat, and the warmth of the hand is rapidly carried off by the metal. On the other hand, a piece of woollen cloth, especially if it has a long nap upon it, does not feel cold because it is a good non-conductor, and prevents the heat passing rapidly from the hand. Now the warmest fabric for clothing is that which is the best non-conductor; and Count Rumford made a great number of experiments with different materials in order to find out the best. According to his observations, the down of the eider duck, which the Esquimaux use in their clothing, is unrivalled in this respect; and the finer the fabric of woollen cloth used, the more imperfectly did it conduct the heat from the human body. As fine woollen cloth is superior to that of coarse wool as a non-conductor, it is therefore the best for clothing in keeping the body warm during cold weather. We are also positive that cloth made of fine wool equal in thickness to that manufactured from the coarser material will wear much longer. The finest woollen cloth, although dearer at first, is cheapest in the end, because it is more durable and warmer; and according to Liebig, so much heat saved is so much meat gained. It must not be overlooked, however, that there may be a very great difference between what is called "firm cloth" and cloth made of fine wool. Fine wool is our theme; it feels pleasant and soft to the touch, and it has a rich velvety appearance. There has been a great demand recently for coarse wool to be used in the manufacture of common army and other cloth, but every effort should rather be made to obtain plenty of cheap fine wool, because it is the warmest and best for clothing.—*Scientific American.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

J. Horsley.—We shall be pleased to receive the paper you speak of, at your convenience.

F. Harrison.—You will obtain better results by having forty Groves' cells of the ordinary size, than by using the same surface of platinum in four large cells. This would be an admirable "quantity" arrangement, but would be very deficient in "intensity," and for brilliant lecture experiments the latter is as necessary as the former. No addressed envelope arrived.

THE CHEMICAL NEWS.

VOL. IV. No. 106.—December 14, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page* 297.)

Synthesis of Nitrate and Sulphate of Lead.—Before explaining how I proceeded with the synthesis of nitrate and sulphate of lead, I ought to point out the means which I made use of to procure pure lead.

Preparation of Pure Lead.—The preparation of pure lead offers perhaps even more difficulty than that of pure silver. After a considerable number of trials, I had recourse to these methods to obtain the metal employed in my experiments. Commercial acetate of lead was dissolved in warm water, contained in a large leaden digester, and kept at a temperature of 40° to 50° in contact with very thin sheets of lead until all the copper and silver were precipitated. The solution was then filtered and poured into nearly boiling water, strongly acidulated with sulphuric acid. The sulphate of lead was washed by decantation until the washing waters contained no trace of sulphuric acid. The salt was then transformed into carbonate by means of a mixture of sesquicarbonate of ammonia and solution of ammonia; for this it is only needful to diffuse it in the water containing the alkaline salt, an effervescence takes place, which lasts as long as there remains sulphate of lead undecomposed. At this point I decant the solution of sulphate of ammonia and the excess of carbonate of ammonia, and wash it with pure water as long as the washing waters contain sulphate in solution.

The carbonate of lead thus formed dissolves entirely in dilute nitric acid. It is perfectly free from foreign metals, except traces of iron, which adhere to the sulphate of lead in spite of the excess of sulphuric acid employed. To separate the iron, I transformed a portion of this carbonate of lead into oxide, by heating it carefully in a platinum vessel. Another portion was dissolved in dilute nitric acid, taking the precaution to leave some of the carbonate undissolved. The solution of nitrate was heated to ebullition, and the oxide of lead was then gradually added to it. The oxide in dissolving precipitated traces of iron. The liquid was filtered and an excess of sesquicarbonate of ammonia poured into it. In the carbonate of lead thus obtained it has been impossible for me to discover the slightest trace of foreign metal. It is this carbonate which I have converted into metallic lead. To effect this, after having dried it, I project it, by small quantities at a time, into pure fused cyanide of potassium. As this reduction ought to be effected in a white, unglazed, porcelain crucible, which is very liable to break, I have had recourse to the same plan which I used in the reduction of silver from its chloride, and in the fusion of the pure metal,—that is to say, I fixed the porcelain crucible in the centre of another larger one, interposing between them calcined pipe-clay, which had been reduced to powder, cementing the whole together by the addition of five per cent. of fused and powdered borax.

The lead obtained by the first operation is heated a second time with pure cyanide of potassium until it presents at the bottom of the cyanide a surface as convex and brilliant as pure mercury. When it is somewhat cool I cast it in a polished ingot-mould of cast steel.

When the lead contains the slightest trace of oxide or sulphide of this metal it does not present a convex surface when it is fused.

Pure lead is much whiter and more soft than the ordinary metal. It appears to tarnish very rapidly when exposed to the air.

Instead of reducing the carbonate of lead by cyanide of potassium, I have employed for this purpose the black flux obtained by carbonising purified Seignette salt. To entirely deprive this salt of foreign metals, I first pass a current of hydrosulphuric acid through its boiling solution; I then pour in a few drops of sulphide of sodium solution. The coloured solution, left to itself for fifteen days in a well-stoppered bottle, becomes completely decolorised by depositing the metallic sulphides. The decanted solution is agitated with tartrate of lead as long as it contains the slightest trace of sulphide of sodium. Before calcining the Seignette salt, I always test it to see that it contains neither sulphide, sulphate, nor foreign metals.

The carbonate of lead mixed with the pulverised black flux is reduced by the action of heat. The temperature necessary for the fusion of the alkali being tolerably high, there are almost always a certain quantity of alkaline metals reduced, which alloy with the lead. To remove these metals, I heat the lead for some time in contact with the air, continually stirring the metallic bath with a rod of pipe-clay. When I have thus oxidised a certain quantity of the lead, I pour on the mass fused cyanide of potassium, and heat the whole until a great portion of the cyanide is volatilised. The lead is then allowed to cool to near its point of solidification, and then run into an ingot-mould of polished steel.

I have also obtained lead by the reduction of the chloride. For this purpose I treated with an excess of dilute hydrochloric acid the carbonate of lead prepared by the action of sesquicarbonate of ammonia upon the sulphate of lead. The minute traces of iron contained in the carbonate remain dissolved in the excess of hydrochloric acid. I made use of two different plans to reduce the chloride. One consisted in mixing it with two-thirds of its weight of pure carbonate of soda and projecting the intimate mixture into fused cyanide of potassium. The metallic lead produced was poured into another crucible with a fresh quantity of pure fused cyanide of potassium. It is there kept at a high temperature and continually agitated until the surface, flat and dull as it is at first, becomes strongly convex and

brilliant. When sufficiently cool it is poured into an ingot-mould and kept away from moist air.

The other plan of reducing the chloride consists in heating an intimate mixture of it with carbonate of soda and black flux. The resulting lead was fused and agitated for some time in contact with air, and then heated with cyanide to remove the last traces of oxide.

Synthesis of Nitrate of Lead.—I effected the synthesis of nitrate of lead in absolutely the same manner as indicated in the case of nitrate of silver, taking all the precautions necessary to arrest the last traces of lead carried off by the gas during the solution of the metal, and sometimes during the evaporation of the solution of lead in nitric acid.

In general, to effect the solution of the metal, I employed the most concentrated acid which was capable of attacking it. Lead decomposes concentrated nitric acid, but very slowly, but, on the other hand, this only dissolves traces of the nitrate. This salt as it is formed precipitates in the form of a crystalline powder. The precipitation of the nitrate of lead during its formation is necessary for the success of the synthesis. This salt, in fact, not supporting an elevated temperature without decomposition, ought to be dried at a comparatively low temperature. The probability of a complete desiccation of this salt is only acquired with difficulty if it is deposited in even not very voluminous crystals, as is the case during the evaporation of a solution of the nitrate. The attack of 150 or 200 grammes of lead by a proper quantity of acid more or less concentrated, and under the influence of a continuous heat of 70° to 80°, requires from thirty-six to forty-eight hours. I have, moreover, found out that when once the action has commenced the heat must be kept up night and day, until the complete dessiccation of the resulting salt. If this precaution is neglected the operation may be considered lost; for in this case when the saline mass is dried it slowly and continuously loses weight for six weeks, as I have found. In all the syntheses which are detailed in the Table I have taken the precaution to keep up the heat night and day after the action has once commenced until it no longer disengages a trace of acid under the influence of a temperature of 125° to 130°. By keeping the globe continually at a temperature notably below the boiling-point of the liquid which it contains, it requires from four to six days to bring to dryness the product of the attack of 150 to 250 grammes of lead. When brought to apparent dryness, 160 to 200 grammes require a continuous temperature of 140° to 155°, to be kept up during eight to twelve days in a current of dry and pure air to be brought to a constant weight. In this state of desiccation the temperature can be raised to nearly 200° in a current of air without experiencing further loss; but a little above that temperature acid vapours are evolved in a continuous manner.

I wished to know to what degree I could rely upon the desiccation of nitrate of lead in the state of a crystalline powder, and I found that 180·557 grammes of this salt precipitated by nitric acid from an aqueous solution, and consequently in the form of a crystalline powder, dried first at 125°, and then heated for three days at a temperature comprised between 125° and 140° lost $\frac{1}{2543}$ in weight. The same salt raised for eight days to 155° experienced a farther loss of $\frac{1}{100000}$ths of its weight. I kept it during thirty-six hours at 155° without causing it to undergo the slightest alteration in weight. From 195° to 200° it again commenced to disengage acid vapours, and did not cease until it was in part reduced to the state of basic nitrate. The limits between the point at which nitrate of lead loses its last trace of acid and water and that at which it decomposes are therefore very narrow. From what I have above stated, this limit does not exeeed 55°. The difficulty which is found in drying the nitrate without decomposing it explains why the results of the analyses of this salt by Berzelius, Anderson, and L. Svanberg agree so imperfectly. I have myself performed a great number which have equally given me the most contradictory figures; but this is of no present importance.

I have made two series of syntheses. In the first series all the nitrate was dried in a current of air. Having conceived some doubts of the possibility of thoroughly drying this salt without decomposing it, I undertook, a year and a-half later, a second series of experiments, but effecting this time the desiccation *in vacuo*. With this object, after having first heated to 80° for eleven days and nights the product of the solution of lead in nitric acid, to bring it to the state of dryness, and after having kept the salt at from 140° to 155° for a hundred and twenty hours, I applied a caoutchouc connector to the flask containing the salt and exhausted the air from it. The salt remained *in vacuo* from eight o'clock in the morning till eleven o'clock in the evening, the temperature being kept all the time at about 155°. During this time I allowed air to enter, and pumped it out again five times. I remarked that the air pumped out of the flask reddened litmus paper contained in a tube which the air had to pass through before arriving at the cylinders of the pump.

These are the details of one experiment. They show what confidence may be placed in the syntheses of nitrate of lead dried in the air :—

	Grammes.
Weight of the flask	493·862
Weight of the lead in air	100·007
Weight of the globe with the nitrate dried at 155° until the weight of the salt was constant	653·8215
Weight of the flask after the salt had been heated to 155° *in vacuo* for three hours .	653·815
Weight of the flask the next day .	653 616[1]
Weight of the flask, the salt having been again heated to 155° *in vacuo* for three hours	653·812
Weight of the flask, the salt having been heated a third time for two hours . .	653·810
Weight of the flask the next day . .	653·8105

Thus, the greatest difference between the weight of the salt dried in air and *in vacuo* is 0·0115 grammes for 159·970 grammes of nitrate.

I repeat, that whatever may be the care which I have taken to obtain the complete desiccation of nitrate of lead, however remarkable is the concordance between the different syntheses, I conceive, however, that there may remain a legitimate doubt as to the possibility of absolutely drying such large quantities of salts when they cannot be raised to a high temperature without decomposition. Further experiment will decide this. All that I dare predict is, that chemists who place themselves under the same conditions as myself will find absolutely the same results.

It remains to be seen whether these conditions are favourable to a research of this kind, and even if the nitrate of lead is not too unstable to be used for a rigorous determination. The lead employed in the syntheses was prepared—

[1] Thus in the original, probably a misprint for 653·816.

For Nos. I. and II. with the pure carbonate and cyanide of potassium.

For Nos. III. and IV. with black flux and carbonate of lead.

For Nos. V. and VI. with chloride of lead, carbonate of soda, and cyanide of potassium.

For Nos. VII. and VIII. with black flux and carbonate of lead.

For Nos. IX. and X. with chloride of lead, carbonate of soda, and black flux.

Synthesis of Nitrate of Lead.

Numerical order.	Weight of the Lead in air.	Weight of the Lead reduced to a vacuum.	Weight of the Nitrate of Lead in air.	Weight of the Nitrate of Lead reduced to a vacuum.	100·000 parts of Lead yield Nitrate of Lead.	
First Series.						
	grammes.	grammes.	grammes.	grammes.		
I.	103·0075	103·000	164·748	164·773	159·973	Dried in air between 140° & 160°.
II.	140·695	140·6887	225·033	225·0674	159·975	
III.	110·2722	110·2672	176·381	176·408	159·982	
IV.	141·999	141·9927	227·118	227·1527	159·975	
V.	148·623	148·616	237·6695	237·702	159·968	
VI.	124·3535	124·348	198·894	198·924	159·973	
				Mean ..	159·974	
Second Series.						
VII.	100·007	100·000	159·948	159·970	159·970	Dried *in vacuo* at 155°.
VIII.	200·014	200·000	319·885	319·928	159·964	
IX.	250·0175	250·000	399·843	399·8975	159·959	
X.	250·0175	250·000	399·860	399·914	159·965	
				Mean ..	159·9645	

(To be continued.)

On the Oxalate of Iron,[1] *by* H. Croft, *D.C.L., Professor of Chemistry in University College, Toronto.*

In No. 48 of the Chemical News, amongst extracts from foreign journals (*Comptes-Rendus*, 51—17), there appeared a short note on the so-called Quadroxalate of Iron, by Dr. Phipson, the formula being given as $FeO.4\,C_2O_3$. The correct name representing its composition being given, it does not appear that there can be any typographical error in the formula, which would otherwise seem likely from the excessive improbability of the existence of an anhydrous quadroxalate of a heavy metallic oxide. The absurdity of the formula becomes still more apparent if the method of preparation be considered, viz. by precipitating ferrous sulphate by oxalic acid, or better by oxalate of ammonia. In this latter case, these two neutral salts must so decompose each other as to produce a highly acid insoluble compound and set free three equivalents of ammonia, by which the supernatant liquid must become strongly alkaline—a species of decomposition the writer believes to be as yet unknown in chemistry.

$$FeO.SO_3 + 4\,(NH_4O.C_2O_3) =$$
$$FeO.4\,C_2O_3 + NH_4O.SO_3 + 3\,NH_4O.$$

It is scarcely necessary to say that nothing of the kind takes place. The salt is described as being yellow, and giving with ferricyanide of potassium a green substance, owing to partial decomposition—a fact which is not altogether incomprehensible when it is remembered that $CfdyK_3$ gives a blue colour with salts of FeO, and that blue and yellow produce green.

It is a pity that Dr. Phipson, when writing on the subject, should not have previously made himself acquainted with facts which have been known for nearly five-and-twenty years, the salt being nothing more than the ordinary oxalate of iron, containing two equivalents of water $FeO.C_2O_3 + 2$ aq. This compound has been described by Vogel and Berzelius, its composition shown by Döbereiner and Rammelsberg, who appear to have proved that it differs from the rare mineral Humboldtite in containing half an equivalent more water, $FeO.C_2O_3 + 1\frac{1}{2}$ aq., and $FeO.C_2O_3 + 2$ aq., or

$$\left.\begin{matrix}C_4O_4\\Fe_2\end{matrix}\right\}O_4 + 3\text{ aq. and }\left.\begin{matrix}C_4O_4\\Fe_2\end{matrix}\right\}O_4 + 4\text{ aq.},$$

corresponding to the manganous oxalate. More recently it has been examined by Souchay and Lenssen in their extended investigation of the oxalates.

In order to test the matter still further, the salt was prepared by my pupils, Mr. Ramsay and Mr. Thompson, in both ways indicated by Dr. Phipson, using a large excess of oxalic acid in the one case and precipitating both from concentrated and from very dilute solutions. In both cases the precipitation takes place almost immediately.

The subjoined quantities of FeO were obtained. It will be observed that the amount of FeO is a little below the requisite quantity both in these analyses and in those of Rammelsberg which are appended, owing to the salt retaining a certain amount of hygroscopic water, unless dried for a long time at 100°; and also to the fact, that when heated it is not perfectly oxidised unless the heat be continued for a long time or the residue be moistened with nitric acid and again heated, as was done in No. I. No. IV. was only air dried.

	Calculated.		I.	II.	III.	IV.
FeO . .	36	40	39·70	38·91	38·68	38·08
C_2O_3 . .	36	40	——	——	——	——
2 HO . .	18	20	——	——	——	——
	90	100				

Rammelsberg.

	I.	II.	III.	IV.	V.
FeO . .	38·78	39·10	38·92	38·84	39·48

Additional Note by the Author.

The 17th number of the *Comptes-Rendus* having come to hand, the writer is enabled to give the analyses on which the above formula is founded, viz:—

FeO	19·35	19·44
C_2O_3	80·65	80·56
	100·00	100·00

From the exact accordance of the analyses, it is evident that the oxalic acid was not determined, but only calculated from the loss, and as the quantity of FeO is exactly one half of that obtained by other chemists, it seems probable that Dr. Phipson has made the ludicrous mistake of calculating the protoxide corresponding to the obtained peroxide as FeO, and not as Fe_2O_2, and considered all the remainder as oxalic acid.

[1] *Canadian Journal of Science*, xxxi. 18.

On the Chemico-Microscopical Characteristics of Butter and Lard, by John Horsley, *F.C.S.*

Hitherto I have had considerable difficulty in applying the microscope to the distinction of these substances, but according to the following method the thing is easy

enough :—Take a piece of each pure butter and lard and dissolve them in a little benzole contained in separate vessels, and allow the benzole two or three days to evaporate as much as possible to near dryness. Then take a small shallow glass dish, place in the centre of it a little of the butter, cover this with a drop or two of strong ammonia, shake the dish for a minute or two to distribute the contents equally, and place it under the microscope. By using a half-inch power, the object glass will be seen to be studded with long black tufts of acicular crystals, such as I alluded to in my former paper, the ammonia appearing to have little or no action on them. The other portion of the butter will be in large transparent masses, which by reflected light are opaque.

Lard, on the other, presents no such appearance, there being only a few small crystalline tufts observable, which disappear after a time, and the whole becomes more or less transparent flakes of an irregular and indented character.

Being called away to the Gloucester Assizes on a professional case, I have not had time to examine other fats; but no doubt, by a similar proceeding, I shall get at their characteristics under the microscope, which I shall have pleasure in communicating if worthy of notice,

The Laboratory, Police Station, Cheltenham.

On Formic Acid and the Hemihedrism of Formiate of Strontia, by M. Jacobsen.

Formic acid, prepared from starch and neutralised with carbonate of strontia, produces, as is known, fine crystals of formiate of strontia with two equivalents of water, which are hemihedral, some being right-handed and others left-handed. M. Pasteur, who noticed this fact, equally remarked that the aqueous solution of this formiate has no action upon polarised light, which he explains by the presence of the two hemihedral forms.

When prepared from oxalic acid and from glycerin, formic acid gives rise to a formiate of strontia similar to the preceding, at least in appearance, but which nevertheless differs sufficiently from it to prevent the admission of the absolute identity of the two acids, and consequently the two salts. The former formiate gives in preference left-handed hemihedral crystals, while the crystals produced by the formiate from glycerin is especially distinguished by right-handed hemihedral facets, the left-handed facets being in this instance in quite a subordinate proportion, while in the formiate from starch the left-handed facets preponderate.—*Annal. de Physik und Chem.*, vol. cxiii., p. 493.

On Certain Properties of the Platinum Metals, particularly Ruthenium, by Dr. Claus.

(Continued from page 258, vol. iii.)

On the other hand, is not rutheniate of potash still more closely connected with ferric salts by its decomposing so readily, and by its similar decomposition also into O_3 and Ru_2O_3? Iron and manganese have also like degrees of oxidation, MO and M_2O_3, similar to the platinum metals, and the combination MO_2, which is wanting in iron, is met with again in manganese. The green solution of manganate of potass has also certain analogies with the blue solutions of a less positive pair,—namely, that of rhodic and iridic acids. But the most striking analogy is that existing between ferrocyanide of potassium and double cyanides with a composition similar to the osmic pair. If the ferrocyanide of potassium, instead of being yellow, were colourless, like the cyanides of these other metals, they might be considered identical, so similar are their reactions. Between the two last terms the iridium and rhodium pair occupy the middle, being connected on one hand with platinum pair and on the other with the osmium pair. I have not been able to discover the relations which may exist between these metals and copper, which is always found in platinum mines, in spite of the isomorphism of the copper with the ferrous and manganous oxides. It is possible that copper ought to be placed between the two terms of the middle of the second series. The property possessed by osmium and ruthenium of forming, with oxygen volatile combinations constituted in an identical manner, removes these metals from the platinum series and from all analogy with iron and manganese and connects them with the metalloids; while, on the contrary, their faculty for forming bases disconnects them from the metalloids. The following Table may help to elucidate the foregoing:—

Horizontal Series.

Positive end of the Horizontal Series.					Vertical Series	Negative end of the Horizontal Series.
	Principal Series	Osmium	Iridium	Platinum		
	Secondary Series	Ruthenium	Rhodium	Palladium		

Our knowledge of platinum metals has been considerably advanced by the new modes of analysis described by French chemists, particularly by the use of peroxide of barium for attacking osmide of iridium, by the new process of pulverising the ore, and by the large number of analyses of platinum ores already made. I have been particularly interested by the description of analyses of varieties of osmide of iridium,—analyses which lead to the conclusion that the quantity of ruthenium in these ores augments with the increase of osmium, and diminishes as the iridium augments,—a result incontestably proved by my own researches, and which is explained by the close connection existing between ruthenium and osmium. It has been equally well ascertained that osmide of iridium, in the form of clear, shining scales and tablets, is the ore containing the largest quantity of these two metals: while the dark gray, dendritic and dull ore often contains very little osmium or ruthenium, though, according to my researches, it is never entirely free from ruthenium. I was, consequently, greatly surprised that French chemists should in two cases have found a Russian ore containing no traces of it. The evident explanation of this fact is the difficulty there is in discovering ruthenium when it exists in the ore only in very small quantity. Fusion with saltpetre and potash would not in this case suffice to reveal the presence of ruthenium. In ores containing much osmium nothing is easier, because the osmium favours the attack on ruthenium. In this case, then, after fusion with saltpetre and potash, a solution of an intense orange colour is obtained, containing hardly any iridium. It is otherwise with ores containing little osmium and relatively, also, little ruthenium. According to the quantity of osmium present, these yield clear yellow, dark green, or even quite blue solutions, which contain much iridium dissolved to the state of iridiate of potash; so that in a blue solution the small quantity of ruthenium there present is entirely masked by the colour of the iridium. Moreover, all the ruthenium does not pass into the aqueous solution at the first fusion of the

powdered ore, but a notable portion of it remains with the undissolved iridiate of potass. This method becomes still more defective when the substance on which we act contains no osmium,—when, for instance, we commence, as our authors have done, by eliminating the osmium and then melting the residue of iridium, containing ruthenium, with potass and saltpetre. These circumstances, unknown to the French chemists, may explain why ruthenium has escaped their analyses.

When ruthenium cannot certainly be discovered by fusion with potass and saltpetre, and when it is necessary to separate it from the other metals, I make use of another method, which I have described elsewhere,—namely, by precipitating ruthenium from a solution of the metallic chlorides, by the addition of a small quantity of ammonia and by boiling. This method also has the disadvantage of succeeding only when there is a considerable quantity of ruthenium; nevertheless, there is at least the advantage of being able to separate the greater part of the other metals which impede the precipitation either by partial crystallisations or by consecutive treatments by water, after which a solution is obtained sufficiently rich in ruthenium to allow of its determination, not only qualitatively, but, in an approximate manner, quantitatively. To this end it is necessary to be acquainted with the following conditions on which this process is founded:—

1. Ruthenium is precipitated as sesquioxide by boiling from solutions rendered feebly alkaline by ammonia. This precipitate is a black, ruthenious sesquioxide. The same effect is produced with osmic chloride, which invariably gives the precipitate OsO_2. Other metals, particularly iridium, give no precipitates under these circumstances. Red ruthenic chloride also yields in this way an ochre-yellow hydrate of ruthenic oxide $RuO_2.5HO$, but this precipitation is incomplete; it is much more certain in presence of ruthenious sesquichloride. Potash behaves like ammonia in this reaction, but its use is not advisable, on account of the facility with which it dissolves the oxide RuO_2. No precipitate is produced if there is much iridium in the solution, but it is easy to determine the presence or absence of ruthenium. In fact, a solution of pure iridium, containing no ruthenium, is instantaneously decolorised by the addition of excess of caustic potass or ammonia. It remains for a long time thus perfectly transparent, and then, after several days, takes a beautiful blue colour. But if the iridium contains traces of ruthenium, the colour of the solution becomes fainter during the reaction, but does not disappear; it passes to a yellow-brown or reddish hue, and does not become decolorised for some time, at which point the solution becomes troubled and a slight brown or yellow precipitate is formed. If the iridium contains more ruthenium, yet not sufficient to produce a visible precipitate, its presence is betrayed by the intense red-purple colour assumed by the liquid, especially if potass is used. These are the most certain reactions for the qualitative determination of ruthenium.

2. Double salts of iridic chloride are not isomorphous with double salts of ruthenious sesquichloride; these salts then never crystallise together, but always separately. The latter are decidedly the most soluble. They are not so easily precipitated when a solution of ruthenioue sesquioxide in hydrochloric acid is treated with ths addition of ammoniacal salts in solution, as when salts of iridium in a solution of iridic chloride are used. Crystals of a salt of iridium are also much larger than those of a salt of ruthenium, to which circumstance the greater solubility of a salt of ruthenium is partly due. When both salts are deposited as crystals, they are each insoluble in a dilute solution of sal-ammoniac, which affords a ready means of freeing them entirely from salts of rhodium and palladious chloride (not palladic chloride), which are freely soluble in the above solution.

3. The double salt of ruthenic chloride is isomorphous with the iridium salt, and can enter as a constituent part of an iridium combination. A small quantity of this salt is always produced simultaneously with the sesquichloride, when ruthenious sesquioxide is dissolved in aqua regia, and the larger the proportion of this mestruum, the more freely is it formed. This being the most soluble of all the double salts of the platinum metals, a large portion remains, even in presence of much iridium, in the mother-water, after the crystals of other salts are deposited.

Fractional Process of Precipitation and of Crystallization.—Osmide of iridium is melted in the ordinary way, with saltpetre and potash, and moistened with water; then carefully neutralised with sulphuric acid in order to precipitate the metallic acids in solution, always leaving the liquid with a slight alkaline reaction; then alcohol is added, and the whole boiled. Throw the mixture on a filter and carefully wash, in order to free it as far as possible from potash salts. The black metallic powder thus obtained still contains much potash, in the state of acid iridiate of potash, which is capable of converting the greater portion of the iridium into double iridic chloride, during the subsequent solution of the metallic powder. For this reason we evaporate to a considerable extent the aqua regia solution separated from the powder, until all the osmium is disengaged as osmic acid; then, if left to cool, the residue is deposited, most of the iridium is deposited in the state of double salt, and the liquid contains all the ruthenium, in a much greater degree of concentration, although always naturally associated with iridium.

We afterwards filter and add powdered sal-ammoniac, which causes the deposition of yet more iridium, as a black crystalline precipitate. The solution generally contains ruthenium so concentrated as to be separable from the iridium by precipitation. Now evaporate again and add more sal-ammoniac until the liquid begins to lose its colour, and most of the platinum metals are deposited as double salts; then leave it for several days, collect the residue on a filter, and wash it with water containing sal-ammoniac in solution, which completely eliminates iron and copper, and does not affect the ruthenium, and we get a residue of salts of iridium containing ruthenium, which, dissolved and boiled, with the addition of a little ammonia, yields a precipitate of ruthenious sesquioxide.

Fractional Method of Extraction.—This process is generally conducted in the same manner as the foregoing. The first quantities of double potassic salts, usually containing no ruthenium, are allowed to crystallise, and the liquid is separated from the crystals. Evaporate the liquid almost to dryness, adding the necessary quantity of sal-ammoniac, and wash the residue with a concentrated solution of sal-ammoniac, to free it from iron and copper. Treat the salt of iridium, containing ruthenium, first with a few drops of hydrochloric acid, so that the ruthenic combination undergoes no decomposition, then with a little water in a flat dish, and leave it for several days. Then filter, and we get a liquid containing most of the ruthenic salt, which, heated with ammonia, as indicated in a foregoing paragraph, yields a voluminous black precipitate, which

does not colour the liquid deeply. The salt of iridium, always charged with ruthenium, which remains on the filter, is again to be treated in a flat dish with a little water, and so on, repeating the same operation so long as ruthenium is dissolved, and until the salt of iridium is obtained pure. Collect all the ruthenium precipitates on the same filter. The aggregate is not then entirely pure, containing a small proportion of iridium; nevertheless, the surplus of iridium is compensated for by the loss always sustained in operating on solutions highly charged with iridium, in which a certain quantity always remains unprecipitated. The first solutions contain most ruthenium, yielding the largest and purest precipitates, without producing much coloration of the liquid. The later solutions, during precipitation, occasion the intense red colour characteristic of the mixture of salts of iridium and of ruthenium. After a time this reaction also disappears, but the solutions continue to yield the ruthenic reactions already described. It is better not to heat these solutions, but, adding a slight excess of ammonia, to leave them at rest at the ordinary temperature of the air, when they soon become turbid and produce a light brown or yellow precipitate, sparingly voluminous, consisting partly of a mixture of sesquioxide of ruthenium and ruthenic oxide, and partly of pure ruthenious oxide. In fact, the salt of iridium, an isomeric constituent with ruthenic chloride, is dissolved, and ammonia, without precipitating iridium, eliminates the yellow ruthenic oxide.

I employed this complicated method to obtain ruthenium from poor ores when unable to obtain rich ones. I have also made use of this mode of analysis in the absence of any better. Not till after the discovery of volatile hyper-ruthenic acid could I employ a simpler and more certain method,—a method based on the volatility of the above-mentioned combination, and on the supposition that the presence of iridium in no way hinders the formation of hyper-ruthenic acid. I was led to the use of this new method by an observation I made ten years ago, that a solution of ruthenium, treated by chlorate of potass and hydrochloric acid, loses all its ruthenium, under the form of a volatile product. Still, this method cannot be regarded as very simple, seeing that the newly-discovered volatile ruthenic combination necessitates certain precautions to avoid loss by volatilisation. There is no appreciable loss in melting ruthenium with caustic potash and saltpetre. A piece of paper soaked with alcohol does not blacken if held even for a long time over the heated mixture, and no smell of hyper-ruthenic acid is observable, though during the solution of the mixture a feeble odour of it is always given off. If ruthenious sesquioxide, which is obtained in treating this solution by alcohol, is dissolved in hydrochloric acid, the solution takes place without forming a volatile ruthenic combination; but there is some likelihood of loss if aqua regia is used as a solvent, for ruthenium is then placed under circumstances similar to those produced by the simultaneous action of chlorate of potash and hydrochloric acid. When it is necessary to estimate ruthenium precisely, the osmium must not be expelled previously by means of aqua regia, otherwise there would be some loss of ruthenium. Keeping these circumstances in mind, the following mode of analysis may be proposed, always admitting the supposition that other metals exercise no influence on the result. For the determination of ruthenium, a larger quantity of the metal than is generally used is required,—that is to say, at least ten grammes, which must all be reserved for the search for ruthenium, disregarding all the other constituents. Then melt the pulverised ore with potass and saltpetre, dissolve it in water, carefully neutralise it with an acid, and, adding some alcohol, heat it; then carefully wash the precipitate, which is a black metallic powder, in water, to eliminate the saltpetre and other potash salts. Dissolve this powder in hydrochloric acid, heat it in a retort with chlorate of potass and hydrochloric acid, and collect the volatile products in condensers containing alcohol. By this means ruthenium and osmium are obtained together, but their separation can be effected by alcohol, which instantly decomposes the ruthenic acid, though it takes some time to reduce the osmic acid; or, the two metals may be precipitated from their solution by sulphuretted hydrogen, and the sulphides thus obtained heated in a small, platinum vessel, in an oxygen current, which disengages sulphur and osmium as acids, while the ruthenium remains as ruthenic oxide. This is only a proposition, which I submit to other chemists, especially French chemists who have ruthenium at their disposal, and who take so much interest in the analysis of osmide of iridium. They will perhaps be induced to undertake these analyses when they read the present Memoir. My own attention being absorbed by other questions, these researches have for me but a secondary interest.

PHARMACY, TOXICOLOGY, &c.

Researches on Hypophosphite of Lime, by M. Gérard Janssen.

1. Preparation.—The hypophosphites are seldom met with chemically pure. This is due to those terrible explosions to which the most skilful operator exposes himself in their preparation. Prompted by a well-grounded fear, he dare not conduct the process to the end, and the product obtained is more or less altered by foreign substances.

The properties attributed to such preparations cannot be those of the hypophosphites chemically pure. The author of these researches sought a new method of preparation, which would permit of obtaining these salts perfectly pure and without danger. He first investigated the causes of explosion. These he found to be due to, first, the action of heat and the oxygen of the air on the phosphuretted hydrogen (PH_3); second, the production of biphosphuretted hydrogen (P_2H); third, the formation of a peculiar and very explosive compound, to which he gives the name of triphosphuretted bi-hydride (P_3H_2). This substance crystallises in hexagonal prisms. As long as the temperature of the mixture remains constant, there is no fear of explosion; but if, after the heat has decreased, it be then raised, the triphosphuretted bi-hydride is instantly decomposed into phosphorus and phosphuretted bi-hydride (PH_2), which takes fire spontaneously. Alcohol is the only compound which prevents these explosions, because it not only arrests the action of the oxygen of the air on the phosphuretted hydrogen and the production of biphosphuretted hydrogen, but also, what is most important, the formation of phosphuretted bi-hydride.

To prepare the hypophosphite of lime, which may be taken as a type of these salts, a sufficient quantity of hydrate of lime is mixed with three times its weight of distilled water, to which a third of pure alcohol has been added. The mixture is introduced into a long-necked flask, heated gently in a sand-bath. When the mixture has attained a temperature of 50° to 60° C.

small pieces of phosphorus are gradually added until the action has entirely ceased. The apparatus is allowed to cool and the solution filtered through asbestos. The filtered liquid is freed from alcohol by distillation in a retort, the residual solution evaporated to perfect dryness, and the white powder thus obtained preserved in well-stoppered glass bottles.

The hypophosphite may be crystallised in the retort by a slow evaporation.

The action of the alcohol is thus explained:—The phosphorus, acting on the hydrate of lime by heat, gives hypophosphite of lime and phosphuretted hydrogen,

$$4P + 3CaO + 3HO = 3(PO,CaO) + PH_3.$$

Two intermediate compounds are also formed,—biphosphuretted hydrogen, and triphosphuretted bi-hydride,

$$8P + 3CaO + 3HO = 3(PO,CaO) + P_2H + P_3H_2.$$

The alcohol decomposes these two compounds, forming phosphide of ethyl.[1] This again is decomposed by the base into hypophosphite and alcohol, a part, however, remaining mixed with the alcohol recovered by distillation. This may serve for a subsequent preparation.

The action terminates by a feeble evolution of hydrogen from the decomposition of the phosphuretted hydrogen, one part becoming combined during the operation with the oxygen of the air, forming water,

$$PH_3 + 2P_2H + 2P_3H_2 + 9C_4H_6O_2 = 9C_4H_5P + 2P + 18HO.$$

$$4P + 3CaO + 3HO = 3(PO,CaO) + PH_3.$$

$$\begin{cases} PH_3 + C_4H_6O_2 = 2HO + C_4H_5P + 2H. \\ PH_3 + C_4H_6O_2 + 2O = 4HO + C_4H_5P. \end{cases}$$

2. Properties.—Hypophosphite of lime is a white powder, inodorous, but of an acrid and burning taste. Deliquescent and very soluble in water; scarcely soluble in ether and absolute alcohol. Soluble in fixed and volatile oils, it is precipitated when they become rancid. It crystallises with difficulty; the crystals contain two equivalents of water (PO.CaO.2HO). Its solution, exposed to the air, is transformed into carbonate and biphosphate of lime. It immediately decolorises a solution of sesquisulphate of manganese ($Mn_2O_3,3SO_3$).

Sulphur, selenium, and tellurium also decompose it into phosphite, then into phosphate, with formation of sulphide, selenide, or telluride of calcium.

Boron, silicon, and carbon, decompose it by heat; borate, silicate, or carbonate of lime is formed, and phosphorus evolved in vapour.

Hydrogen decomposes it into phosphate and phosphuretted hydrogen.

Hydrochloric, hydriodic, hydrobromic, and hydrofluoric acids decompose it into phosphate, phosphuretted hydrogen, and a haloid salt.

Nitric acid converts it into phosphate, hyponitric acid being evolved.

The alkaline bases decompose it into phosphate and phosphide.

The alkaline carbonates when boiling, and the alkaline sulphates in the cold, transform it into an alkaline hypophosphite and carbonate or sulphate of lime.

It precipitates metallic gold from its solutions.

In a solution of nitrate of silver it produces a white precipitate, which rapidly turns brown; if the hypophosphite be added in excess in the cold it reduces the silver to the metallic state after some time; by the aid of heat the reduction is more rapid.

In a dilute solution of bichloride of mercury it produces a crystalline precipitate of chloride. If added in excess it reduces the mercury to the metallic state.

From a solution of sulphate of copper it precipitates the oxide, which a continued ebullition reduces to the metallic state.

3. Adulterations. — Hypophosphite of lime may contain phosphite, phosphate, or carbonate of lime. These three adulterations are separated by cold, distilled water, in which they are insoluble. The first gives off hyponitric acid when acted on by concentrated nitric acid; the second, calcined with a soluble salt of lead, gives globules which crystallise in regular polyhedrons; and the third gives off carbonic acid when treated with a strong acid.

It may also be adulterated with chloride of sodium, sulphate of lime, carbonate of magnesia, and oxide of zinc. These can be recognised by their usual tests.—*Répertoire de Chimie.*

[1] The phosphide of ethyl thus obtained, when separated from the alcohol, is a limpid fluid, of a phosphuretted odour and burning taste. It is very volatile, burning at 9° C. It is soluble in alcohol; the solution has an opaline appearance. In water it separates in drops, like chloroform, which it also resembles in its anæsthetic properties. It burns with an emerald-green flame, exhaling an intensely disagreeable odour. A little powdered tin, bismuth, or antimony, placed in the flame, causes the colour to pass to pale violet, and finally to pure white. The great danger which attends the preparation and manipulation of this substance has not yet permitted the author to study all its properties.

On the Chemical Constituents of Coca Leaves, by Jno. M. Maisch.

These interesting leaves are beginning to attract considerable attention both in Europe and America; the accounts of learned travellers and of physicians, who have lived for a number of years in the districts where Erythroxylon coca is cultivated, and where the leaves are employed for the preservation of the bodily strength amid continued hardships, all these accounts agreeing in the main points, it was natural to expect that the reflecting physician would desire to investigate their adaptation for the cure of disease. The greatest drawback to such investigations is undoubtedly the limited supply of the leaves, but I believe a sufficient quantity might be found in the United States for experiments in our hospitals.

Several papers have within the last year found their way into the scientific journals; among these an analysis of the leaves performed by Dr. A. Niemann, in page 47, Vol. IV. of the Chemical News. The principal object of his investigations was to search for an alkaloid, which he separated in a pure state and analysed. The wax and tannin were separated incidentally in the process for liberating the alkaloid, so that we are still in the dark about its other constituents.

A few months ago, I obtained through the kindness of Professor Procter, a few ounces of coca leaves for the purpose of analysing them. I should have desired very much to pay attention likewise to those constituents which are probably of less importance in regard to their medical properties, but at all events I had to follow the course marked out by Dr. Niemann, so as not to lose the opportunity of obtaining a little of the new alkaloid, and study the other substances isolated by him.

Accordingly, 1500 grains of the coarsely-powdered leaves were exhausted in a funnel-displacer by alcohol mixed with a little sulphuric acid. The dark coloured brown-green tincture was agitated with an excess of milk of lime, which assumed a brownish-green colour; the filtrate therefrom, together with the washings with cold alcohol, was carefully neutralised with sulphuric acid, filtered from the greenish sulphate of lime and distilled. The aqueous residue separated but little resinous

matter, the filtrate therefrom was precipitated by carbonate of soda and the alkaloid gained in an impure state by shaking the mixture with ether and evaporating the light straw-coloured ethereal solution. The yield was four grains, and the alkaloid showed the behaviour described on page 48, Vol. IV. Chemical News.

On adding the milk of lime to the acid tincture, the peculiar tea-like odour of the leaves was strongly developed; but on the addition of the carbonate of soda another heavy and narcotic odour is observed; this is described by Maclagan and Niemann as reminding of nicotina. I observed this slight resemblance, but still the odour is very different.

I likewise found Dr. Niemann's statements correct regarding the vegetable wax and the tannin; though, owing to the small quantity operated on, I was unable to obtain the former in a snow-white condition. The second acid, which Niemann considers as tannin modified by nitric acid, I obtained also in solution contaminated with some of the latter acid.

The alkaloids of coffee and cacao, which, though in a less degree, possess properties similar to those of coca, contain more nitrogen than any other alkaloid known. The small per-centage of nitrogen ascertained in cocaina by Dr. Niemann, suggested the idea that it might probably be a product of decomposition, and that the odour developed by carbonate of soda, might perhaps be a nitrogenous body or another alkaloid. To ascertain this, and to find out whether one or two acids were contained in the tincture, the above process was repeated with the balance of leaves, weighing less than an ounce. The liquid, together with the precipitate occasioned by carbonate of soda, was introduced into a retort, the neck of which was connected with a bent glass tube, dipping into a little dilute muriatic acid. When heated over the spirit lamp, the concussions were so violent that it was deemed advisable to place the retort in a sand bath, so as to supply from the sides sufficient heat to distil the volatile substances, until a syrupy liquid remained behind, from which the alkaloid was separated by ether.

The muriatic acid, which was perfectly clear and colourless, now had an odour somewhat different from the original odour of the alkaline liquid, but it resembled that of the residue in the retort. The acid solution was rendered alkaline by carbonate of soda and agitated with ether, which took up the odorous principle leaving it behind on spontaneous evaporation as a soft resin-like coating. The odour of this mass is heavy, narcotic; the taste similar, somewhat acrid; the behaviour to test paper, neutral, but exposed to the damp atmosphere of a rainy day, it had almost completely lost its odour and acquired an acid reaction and taste, and was now easily soluble in water and alcohol; the solubility of the odorous mass in these menstrua had not been tried. I omitted to mention that the hydrochloric acid solution was tested with the usual reagents for alkaloids: phosphomolybdic acid, and the chlorides of gold, mercury and platinum, without being disturbed by either.

This odorous principle, which I regard as a product of decomposition of some constituent, is therefore volatile with the vapours of water in a slight degree, but very changeable at least in a moist atmosphere. It is likely to be of great importance, as it is stated by several observers that an infusion of the leaves has different properties from the same leaves chewed with an alkali. Whether or not it is nitrogenous, must at present be left undecided.

The solution from which the alkaloid had been removed by ether, was digested with precipitated carbonate of baryta, which removed all the sulphuric acid, and acquired a pale greyish-white colour. The filtrate was neutralised with acetic acid, and after the expulsion of the carbonic acid, rendered very slightly alkaline by a few drops of liquor ammoniæ. An aqueous solution of neutral acetate of lead was now carefully dropped in, as long as a dirty greenish-brown precipitate was produced, which is voluminous, but settles in a few minutes and may be readily filtered and washed. On the further addition of neutral acetate of lead, a precipitate is separated which is at first yellowish-white, but settles readily to a greyish yellow.

The liquid filtered from this last precipitate is not disturbed on the further addition of sugar of lead, but yields with basic acetate of lead a nearly white voluminous precipitate, which is insoluble in water, but readily soluble in acids. Corrosive sublimate and deutonitrate of mercury do not disturb it; protonitrate of mercury yields a whitish precipitate, insoluble in water, almost entirely soluble in nitric acid; the white precipitate by nitrate of silver is scarcely taken up by nitric acid, but readily by ammonia. The liquid contains a small quantity of muriatic acid, but besides it an organic acid which imparts to it a brownish-yellow colour. This colour becomes deeper on exposure to the air, and after twenty-four hours' standing neutral acetate of lead produces a precipitate which resembles in colour the yellowish-white precipitate spoken of before. The filtrate was now of a pale yellow colour, and was not further disturbed by acetate or subacetate of lead after exposure to the air.

The first of the above-mentioned lead compounds dried to a dirty yellowish-brown powder; the second to a powder of a similar, but lighter colour.

The alkaloid which had been separated by ether from the alkaline solution left behind in the retort, was obtained as a transparent mass of the consistence of balsam tolu, a somewhat lighter colour, and of a heavy narcotic odour. All attempts to crystallise it failed, but it had still an alkaline reaction to test paper, was insoluble in water, but soluble in acids, which it completely neutralised. The solution in hydrochloric acid yielded with alkalies and their carbonates a white precipitate soluble in ammonia, with phosphomolybdic acid a voluminous yellowish-white, with bichloride of platinum a yellowish-grey, with terchloride of gold a bright yellow, with bichloride of mercury a voluminous white, afterwards flocculent, with iodine an orange-brown precipitate; no coloration was produced by this alkaloid with oxidising agents.

It will be seen from these experiments that this uncrystallisable alkaloid had very nearly the same behaviour as pure cocaina, the principal difference being the reaction with iodine, which, with the former, is of a somewhat lighter colour with a slight yellow tinge. Heat, it appears, therefore, renders it amorphous; what part the water and carbonate of soda take in this change must be determined by experiments with the pure alkaloid. But it is very likely that the yellowish-brown matter, which Dr. Niemann found so difficult to separate from cocaina, is this same alkaloid in an amorphous state.

My experiments likewise render it more than probable that the substance named cocatannic acid by Dr. Niemann, is a product of oxidation, the original compound of which yields with acetate of lead from a slightly ammoniacal solution no precipitate, but after previous oxidation by the atmosphere, precipitates it, and the precipitate has, according to the length of exposure, a colour varying from white to yellow and brown. As it

is so readily affected by the atmospheric oxygen, great care is necessary in its separation from the other constituents.—*American Journal of Pharmacy.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 5, 1861.

Dr. W. A. Miller, *F.R.S., in the Chair.*

Dr. Oppenheim read a paper "*On the Camphor of Peppermint.*" This substance had been known for some time, but had lately been introduced in larger quantities than formerly. It was imported chiefly from Japan, packed in earthen vessels and presented an appearance resembling crystallized sulphate of magnesia, which in fact was sometimes employed to adulterate it. When washed with warm water and fused, it resembles common camphor; it melts at 36° C., and boils at 210°; these properties coinciding with those of the stearoptene examined by Dumas, obtained from American oil of peppermint. Its composition, as determined by analysis, agreed with the formula $C_{10}H_{20}O$. The corresponding hydro-carbon had also been prepared, its composition being $C_{10}H_{18}$. Some doubt still existed as to the constitution of this camphor, which appeared to border both on fatty and aromatic bodies; it differs from the camphor of Borneo by two equivalents of hydrogen, from ordinary camphor by four equivalents, and from capric acid by two of oxygen; it turns the plane of polarization to the left, and when crystallized from an alcoholic solution of soda, forms long needles. When exposed to the action of gaseous sulphurous or hydrochloric acid a compound is formed, but after some time the gas is given off and the camphor left; concentrated acids dissolve it freely, and it is reprecipitated by dilution or by neutralization with alkali, as an oily liquid which soon changes to the solid state. When heated to 170° C. with concentrated acetic acid the two combine to an oil which is not decomposed by water, and which distils at about 223°; the same reaction takes place with the anhydrous acid, and the composition of the body formed is represented by the formula

$$\left.\begin{matrix} C_{10}H_{19} \\ C_2H_3 \end{matrix}\right\} O,$$

one equivalent of hydrogen being substituted by acetyl. This substance turns the plane of polarization to the left more strongly than the camphor, an alcoholic solution of soda decomposes it with reproduction of the original camphor. Butyric acid also combines with this substance, and corresponding compounds with hydrochloric and hydriodic acid exist. When exposed to the action of sodium, hydrogen is evolved and a compound containing about one equivalent of sodium is obtained, which is decomposed by water but dissolves in alcohol and iodide of ethyle; on heating the latter solution crystals of an organic body containing iodine are deposited, and eventually iodide of sodium is formed. From these properties it was concluded that this camphor was a monatomic alcohol belonging to the series represented by the general formula $C_nH_{2n}O$: the name "menthol" was proposed for this body. By the action of anhydrous phosphoric acid or chloride of zinc, the corresponding hydro-carbon was obtained, and by exposing this to the action of bromine, a compound, $C_{10}H_{17}Br$, was formed, which was decomposed by potash with production of the hydro-carbon, $C_{10}H_{16}$. The corresponding acid had not as yet been formed, oxidising agents attacking the carbon of the camphor instead of the hydrogen.

Dr. Odling thought that the experiments detailed did not prove this body to be an alcohol.

Dr. Oppenheim replied that, according to Berthollet's definition, an alcohol is an organic body which does not contain nitrogen, and which combines with acids giving up an equivalent quantity of hydrogen.

Mr. Church remarked that the process for the formation of campholic acid by passing camphor vapour over soda-lime, contained in a tube and heated, yielded it in very small quantities, and that he should be glad to hear of a better process.

Dr. Frankland having taken the chair,

Mr. J. C. Foster read a paper, "*On Piperic and Hydropiperic Acid.*" From the analyses that had been formerly made of piperic acid, three formulæ had been proposed, namely, $C_{26}H_{12}O_8$, $C_{50}H_{24}O_{16}$, and $C_{50}H_{22}O_{16}$, the last being preferred; the formula $C_{12}H_{10}O_4$ had also been given, the acid being considered monobasic. Mr. Foster's analyses confirmed the formula $C_{12}H_{10}O_4$ for the acid, and $C_{12}H_9MO_4$ for its salts. He had thought it possible that by the action of reducing agents a compound of the formula $C_{12}H_{10}O_2$ might be formed, and with this view the action of hydriodic acid was tried; this substance, however, charred the acid at a temperature below 100°. When submitted to the action of an amalgam of sodium, piperic acid yields a substance containing two additional equivalents of hydrogen, for which he proposed the name of hydropiperic acid, the composition being $C_{12}H_{12}O_4$. The hydropiperic acid melts at 64° and solidifies at about 56°, is not volatile without decomposition, is very slightly soluble in cold, more soluble in hot water, and on cooling the hot aqueous solution, it separates as an oil, which afterwards solidifies; it is soluble in alcohol and ether and may be obtained in large crystals from these solutions; with strong sulphuric or nitric acid it gives a red colour, and with dilute nitric acid a nitro product; when heated with excess of alkali, an acid of the formula $C_7H_6O_4$ was formed, which had already been prepared from piperic acid by the action of potash, and had been named proto-catechuric acid. Various salts of the hydropiperic acid were then described, among others an acid potash salt prepared by boiling carbonate of potash with an alcoholic solution of the acid; this salt was gradually decomposed by recrystallization, and completely by solution in water, the neutral salt being produced. The ether was prepared by passing hydrochloric acid gas into an alcoholic solution of the acid, a brown oil being formed, which, by the action of gaseous ammonia, furnished a substance which was probably hydropiperamide. With chloride of acetyl a neutral oil was obtained in which one equivalent of the hydrogen of the acid was replaced by acetyl.

Dr. Frankland remarked that there was still a possibility of a reduction of piperic acid, although one or two reducing agents had failed; for since weak oxidizing agents were sometimes found to act more completely on certain bodies than powerful ones, the same might be found to be the case with reducing agents.

Dr. Odling inquired whether hydropiperic acid was an appropriate name for a substance having such a relation with piperic acid.

A paper by Dr. Daubeny, "*On the Power Possessed by the Roots of Plants of Rejecting Poisons,*" was then read. The results of some former experiments in which the poisonous substances were applied to the plants after they had grown up, had already been communicated to the Society; in the present experiments these were introduced into the soil before the seed was sown; the substances tried being nitrates of baryta and of strontia, and arsenic acid instead of the arsenious acid used in the former experiments; barley and turnips were the crops employed, and the introduction of the poisonous bodies seemed rather favourable than otherwise as to the quantity of crop obtained. Neither of the substances tried were absorbed under these circumstances, and the only question that remained was whether the quantities employed were sufficient; a larger dose of arsenic, however, killed the plants,

but he proposed to try the effect of larger doses of the baryta and strontia salts.

Dr. Frankland remarked that perhaps the plant absorbed very small quantities of these substances, and afterwards rejected them, so that the amount present in the plant at any one time was not sufficient to be detected.

The next paper was by Professor Bolley, "*On the Physical Properties of Alloys of Lead and Tin.*" The specific gravity of these alloys was subject to great variation, but an alloy containing equivalent quantities of lead and tin appeared to stand lowest in the series, an increase in the quantity of either metal causing an increase in the gravity. From this it was concluded that it was unsafe to infer what were the proportions of the metals in the alloy, from the specific gravity. With respect to the melting points there were great discrepancies in the determinations, but the solidifying point seemed to be more trustworthy; two solidifying points were observed to exist in every case, for an alloy of the composition Sn_3Pb remained liquid, the excess of metal, whether tin or lead, solidifying first. This alloy solidified at 181° C. which was lower than the melting point of either tin or lead.

The next paper was also by Professor Bolley, "*On the Dangers Arising from Feeding Steam Boilers with Certain Waters.*" It had hitherto been considered that waters containing only the carbonates of lime and magnesia were better for feeding boilers than those containing also sulphate of lime, because the sulphate made the deposit more stony, and the usual remedy recommended in the case of a water containing sulphates, was an alkaline carbonate, which decomposed the sulphate of lime; he had, however, found that some boilers which had been fed with water containing no sulphates, formed a stony incrustation to such an extent that the iron flue passing through the boiler became red hot. On inquiry it appeared that the refuse of some bleaching works was discharged into the river from which the supply was drawn. This refuse had a small quantity of fatty matter with it, which, although in very small quantity, completely prevented the deposit in the boiler being wetted by the water, and in fact, by digesting the deposit with ether, a perceptible quantity of fat was obtained. The same stony deposit was formed in another boiler in which the feed water was taken from the condenser of an engine, and in this case, also, a small quantity of grease was found to be the cause, and the addition of a little carbonate of soda to the water completely overcame the difficulty. The flues had only become red-hot when coal was substituted for wood, which had been previously employed as fuel, the coal giving a more intense local heat.

Mr. Perkin remarked that he had found common clay, added in small quantities to the feed-water, prevented the adhesion of the deposit to the boiler.

Dr. Frankland alluded to a similar case of a boiler forming a thick stony deposit, which had come under his own notice; in this case the feed-water was contaminated with organic matter, which caused it to have a sort of glutinosity; it might be poured from a great height without breaking into spray. The organic matter in this case was volatile, and was derived from the refuse of a starch factory, which was discharged into the river from which the supply was drawn.

NOTICES OF PATENTS.

663. *Manufacture of Gas from Coal, Oil, or Oleaginous Substances.* J. I. Taylor, Manchester. Dated March 16, 1861.

The present invention relates to improvements upon an apparatus for manufacturing gas from the substances named in the title, for which the patentee formerly obtained letters patent bearing date March 21, 1860. These improvements consist in the insertion of one or more diaphragms within the body of the retort, which otherwise retains the shape of that formerly used, the object of such addition being the increase of the heating surfaces, and, by a longer passage for the gas, more thoroughly effecting the conversion of the oily substances. With a view to economising the waste heat of the furnaces supplementary drying ovens and water-tanks are provided, the latter being connected directly with the retort and serving as a condensor for the liquid products of decomposition.

678. *Soap.* C. N. Kottula, Holborn, London. Dated March 18, 1861.

This invention refers to the introduction into soap of one or more of the following substances:—Bees'-wax, Japan wax, stearine, sperm, and similar materials. The patentee recommends also the combination of resin with soap, employed alone, or conjointly with one or more of the substances already named. These materials should be dissolved previously to their being mixed with the bulk of the soap.

The addition of yellow bees'-wax, or the white wax of Japan, would raise the cost of production without contributing in the same measure to improve the excellence of the soap. It is possible that from the high fusing points of these materials the compound soaps would be firmer, or could be made to hold a larger proportion of water. The addition of resin is an old expedient, and frequently practised in the manufacture of the lower qualities of soap.

717. *Soap.* F. G. Wagon, Issy, near Paris. Dated March 22, 1861. (Not proceeded with.)

The inventor purposes to employ, as an earthy base in the manufacture of soap, carefully-washed kaolin, or China clay. This is recommended to be mixed by trituration with caustic potash, dissolved in water in the proportion of about one ounce of potash in the pint of water, and then added to the bulk of soap. For toilet use, the employment of glycerin and the ordinary perfumes is specially advised.

Of the mineral substances employed in the adulteration of soap, kaolin is that most frequently introduced. Its addition, like that of resin described in the preceding specification, is not calculated to improve the quality, but rather to increase the weight of the soap, serving only the same purpose as was pointed out by us[1] in reference to the manufacture of paper according to certain systems adopted in foreign countries.

684. *Preparation of Fish and Marine Animals for Manure.* J. Jerrell, Molde, Norway. Dated March 19, 1861. (Not proceeded with.)

By means of crushing rollers and suitable machinery it is proposed to break up the bony structure of the fish, and to subject the comminuted material to the action of a centrifugal drying apparatus and to an after desiccating treatment. By such a process it is stated to be possible to preserve the animal matters from decomposition until they are actually spread on the land to serve the purpose of manure.

697. *Preparing Caoutchouc for Dental Purposes, &c.* R. A. Brooman, Fleet Street, London. A Communication. Dated March 20, 1861. (Not proceeded with.)

The inventor treats the ordinary red caoutchouc of commerce in the following manner to render it suitable for moulding dental pieces, (artificial gums,) and other objects to which the flesh-coloured material is applicable:—The red caoutchouc, coloured with vermilion or other pigment,

[1] Chemical News, vol. iii., p. 329.

is first softened by sulphide of carbon, ether, chloroform, or other solvent employed in proportions varying from one quarter up to an equal weight with the caoutchouc; when so softened or dissolved an appropriate quantity of any of the white pigments specified is added for the purpose of altering the colour from red to pink, and to increase the brilliancy a little carmine may occasionally be added with advantage. Oxide of zinc is used alone or in conjunction with carbonate or sulphate of baryta, sulphate of strontia, or of manganese, phosphate of lime, calcined alumina or silica, or the latter in its precipitated condition. The decolourising agent is usually introduced in quantity about equal by weight to that of the red caoutchouc, and in some cases a small proportion of ordinary caoutchouc solution is required for the purpose of giving the paste more elastic qualities. After moulding, the dental piece or other object must be solidified by exposure in a closed vessel to temperatures ranging between 300 and 335 degrees Fahrenheit, from half to three-quarters of an hour being generally sufficient to communicate the requisite degree of hardness. The flesh colour will be improved by exposing the piece to the influence of the sun's rays, either directly or when immersed in a bath of alcohol.

Grants of Provisional Protection for Six Months.

2356. George Roberts, Bessborough Place, Pimlico, Middlesex, and Frederick Lambe, Cushion Court, Old Broad Street, London, "Certain improvements in lamps and lamp wicks, whereby they are adapted for more effectively burning animal, linseed, and other heavy and also glutinous and bituminous oils, and other burning fluids employed for illuminating purposes."—Petition recorded September 20, 1861.

2527. William James Williams, Warnford Court, London, "An improved process of charging illuminating gas with the vapour of the hydruret of carbon, for the purpose of increasing its illuminating properties."—Petition recorded October 10, 1861.

2553. Robert Charles Furley, Edinburgh, Midlothian, N.B., "An improvement in coating pills for rendering them tasteless."—Petition recorded October 12, 1861.

2725. William Cook, Beaufort Villas, Brixton, Surrey, and Henry Cook, Manchester, "Improvements in printing telegraphs."—Petitions recorded October 30, 1861.

2781. John Peter Bourquin, Newman Street, Oxford Street, London, "Improvements in ornamenting the covers of photographic albums, books, writing cases, and other like articles."

2783. Henry Orth, Wissenbourg, France, "An improved soap."

2784. George Tomlinson Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in electro-plating or depositing metals."—A communication from Jabez Ellis, Walcot, Boston, Massachusetts, U.S.—Petitions recorded November 5, 1861.

2787. Alexander Prince, Trafalgar Square, Charing Cross, London, "Improvements in furnaces for reducing zinc ores."—A communication from Adolphe Charlier, Stolberg, near Aix-la-Chapelle, Prussia.

2795. John Richardson Wigham, Capel Street, Dublin, "Improvements in apparatus for the manufacture of gas, parts of which are also applicable for cooking purposes."

2800. William Albert Shepard, Pall Mall, London, "Improvements in preparing and treating gutta-percha and india-rubber."

2101. John Barrow, Dalton Chemical Works, West Gorton, near Manchester, Lancashire, Improvements in the manufacture of benzole, naphtha, naphthaline, aniline, and carbolic acid."—Petitions recorded November 7, 1861.

2819. Richard Archibald Brooman, Fleet Street, London, "Improvements in obtaining alkaline phosphates."—A communication from Edouard Aubertin, Paris.

2822. William Edward Newton, Chancery Lane, London, "Improved apparatus for manufacturing and containing goseous liquids."—A communication from Pierre Prudence Henri Couillard, Rue St. Sébastien, Paris.

2831. George Fergusson Wilson and George Payne, Sherwood Works, Battersea, Surrey, "Improvements in treating fatty and oily matters."

2844. Louis François Duval and Louis Andre Beaudet, Boulevart St. Martin, Paris, "A new process of tanning."—Petitions recorded November 12, 1861.

2850. William Clark, Chancery Lane, London, "The application of electricity in refining cast iron for the purpose of converting it into wrought iron or steel with or without the addition of other agents."—A communication from François Alphonse Adéodat Dufournel, Boulevart St. Martin, Paris.

2860. Richard Archibald Brooman, Fleet Street, London, "Improvements in albums for containing photographic and other pictures."—A communication from Auguste Marion, Paris.

Notices to Proceed.

2540. Charles Noyes Kernot, Gloucester House, West Cowes, Isle of Wight, Southampton, and Martin Diederich Rucker, Fenchurch Street, London, "Improvements in the method of obtaining ammoniacal salts and other valuable products from liquors or substances containing ammonia, and for utilising the residuum."—Petition recorded October 11, 1861.

2754. John Charles Wilson, Bucklersbury, London, "Improvements in machinery or apparatus for the manufacture of sugar."—Petition recorded November 2, 1861.

1774. Rees Taylor and Thomas Price, Tydu Tin Plate Works, Bassaleg, Monmouthshire, "Improvements in the manufacture of tin and terne plates."

1792. Charles Denton Abel, Southampton Buildings, Chancery Lane, London, "Certain new alloys of silver with other metals, and the processes employed in their manufacture."—A communication from Henri Catharine de Roulz, Paris.—Petitions recorded July 16, 1861.

1819. Robert Laing and George Horwood Cossins, Ince, near Wigan, Lancashire, "An improved mode of obtaining nitrous acid gas for making sulphuric acid."

1836. Constantine Nicholaus Kottula, Holborn, London, "Certain new compositions to be used in the manufacture of soap."

1956. William Clark, Chancery Lane, London, "Improvements in bleaching and clarifying saccharine matters, and in apparatus for the same."—A communication from Messrs. Edouard Théophile de Gemini and Edmond Oswald de Gemini, Boulevart St. Martin, Paris.—Petition recorded August 6, 1861.

2073. Thomas Sutton, King's College, London, "An improved camera for taking photographic portraits and instantaneous pictures."—Petition recorded August 20, 1861.

2860. Richard Archibald Brooman, "Improvements in albums for containing photographic and other pictures."—A communication from Auguste Marion, Paris.—Petition recorded November 13, 1861.

CORRESPONDENCE.

Chemical Nomenclature.

To the Editor of the Chemical News.

Sir,—As it appears to be the fashion to find fault with our unfortunate chemical nomenclature and to propose new systems, perhaps I may be allowed to make a few remarks on the subject. I have read with interest Mr. Newlands' ingenious proposal for the simplification of chemical nomenclature, but, unless I am somewhat mistaken, it resembles very much the methods proposed by Dumas, Gmelin, and

Laurent, not only in its principles, but also in its results. These celebrated chemists were induced to abandon, or at any rate to modify to a very considerable extent, their methods of nomenclature, on account of the very complicated names at which they arrived; and I am almost afraid that Mr. Newlands has scarcely overcome this inconvenience, as his name for acetic acid (dagdatic acid) is not very much simpler than Laurent's term, "linavinam" for alcohol, and, in Laurent's words, I fear that, "in spite of their shortness, they have no chance of being adopted." Again, as the number of elements contained in the body increases, so the name becomes more complicated; thus, for ordinary alum we have the oft-quoted appellation, atolan-telmin-ojafin-weso. This name, although expressing most completely the composition of alum, even to the water of crystallisation, I think would not be adopted by many chemists. It would be well, certainly, to assign names expressing the composition to every new body that is discovered; but it would be somewhat difficult to change the names of all existing bodies, although there would certainly be many advantages in making the name of a substance express its composition.

There is one thing that ought certainly not to be lost sight of in any new nomenclature that may be proposed, and that is, that the constitution and type of a body should be expressed by its name as far as possible. This, as far as I know, has only been done in the case of the derivatives of ammonia, which is really the only part of the present chemical nomenclature that is at all systematic. Here we find something like what a nomenclature ought to be. The derivatives of this type, when basic, are called amines, and when neutral, amides. A basic compound derived by the replacement of hydrogen in one equivalent of ammonia is called a monamine; one derived from two equivalents of ammonia is a diamine; and one from three equivalents, a triamine, &c. These, again, are divided into primary, secondary, and tertiary monamines, diamines, triamines, &c. If the nitrogen in ammonia and its derivatives be replaced by phosphorus, arsenic, or antimony, we then have the phosphines, arsines, and stibines, which are divided into classes in the same manner as the nitrogen compounds. The most complicated of all these bodies is expressed by a simple name, although probably a long one. Let us take, for example, the compound called succinyldisulphophenyldibenzoyldiamide. This is certainly a long word, containing not less than fifteen syllables, but it immediately tells us, as well as a name can, what this body contains and some of its properties. Beginning at the end of the word, we find the substance is a diamide,—that is, a neutral derivative, produced by the replacement of hydrogen in two equivalents of ammonia, and the hydrogen is replaced by one equivalent of succinyl, two of sulphophenyl, and two of benzoyl. The formula is, therefore:—

$$\left.\begin{matrix}(C_4H_4O_2)''\\(C_6H_5SO_2)_2\\(C_7H_5O)_2\end{matrix}\right\}N_2.$$

The name does not give us the composition of the radicals. Some proposal that would give short, concise, and expressive terms to these radicals would be a great advantage.

As this portion of our nomenclature seems so simple, it would not be advisable to alter it, at least, not at present; and if a nomenclature that would not interfere with the designation of the derivatives of ammonia could be found, it would stand more chance of adoption. It scarcely becomes one like myself to suggest any such system, but perhaps I may be allowed to say a few words in explanation of a system which has struck me as being not altogether destitute of advantages, and which, although I cannot and do not expect that it will ever be adopted, may prove acceptable to some of your readers, who may be able to improve upon it.

Chemical compounds were arranged by Gerhardt under four types,—viz., hydrogen, HH; hydrochloric acid, HCl; water, H_2O; and ammonia, H_3N. However, hydrochloric acid is a derivative of hydrogen; therefore, all its derivatives are also derived from hydrogen. Consequently, the hydrochloric acid type may be left out of consideration as a separate type. Since Gerhardt's time, however, another type has been proposed,—viz., the marsh gas, H_4C, or the siliciuretted hydrogen type, H_4Si.

The names of the ammonia derivatives we have already spoken of; so we have the remaining three types,—the hydrogen, HH; the water, H_2O; and the marsh gas, H_4C.

We have first to fix upon a general termination for the derivatives of the three great types; and in the first type, that of hydrogen, *ide* might be convenient, as this type embraces all the hydrides, chlorides, bromides, iodides, fluorides, &c.; and as the termination *ide* would remind us of these combinations, it might be thought applicable in this case, but, for reasons that will appear immediately, the French termination *ure* will be more appropriate. Thus, as ammonia is trihydramine (I never heard it called by this name), hydrogen will become dihydrure, and the designations of the derivatives of hydrogen follow as a matter of course.

The one equivalentic metals, potassium for example, will be called dipotassiure; and the two equivalentic metals, as platinum, will be platinicure. (These terms are never likely to be used, any more than the name potasside of potassium for KK.) In the following list are a few of the organic derivatives of hydrogen:—

Hydride of ethyl	C_2H_5H	ethylhydrure.
Dihydride of ethylene	$(C_2H_4)''H_2$	ethylenedihydrodiure, or more simply, ethylenedihydrure.
Ethyl	C_2H_5,C_2H_5	diethylure.
Methylethyl	CH_3,C_2H_5	methylethylure.

Some of these terms are nearly as simple as the ordinary ones, but I cannot say this for the diethylure. The acid hydrides are:—

Hydrochloric acid	HCl	hydrochlorure.
Water	H_2O	dihydro-oxydiure, or dihydroxure.
Ammonia	H_3N	trihydronitrotriure, or trihydronitrure.
Marsh gas	H_4C	tetrahydrocarbotetrure, or tetrahydrocarbure.

The derivatives of hydrochloric acid are named without difficulty:—

Chloride of potassium	KCl	potassiochlorure.
Dichloride of platinum	$Pt''Cl_2$	platinico-dichlorodiure, or platinico-dichlorure.
Trichloride of gold	$Au'''Cl_3$	aurotrichlorotriure, or aurotrichlorure.
Chloride of ethyl	C_2H_5Cl	ethylchlorure.
Dichloride of ethylene	$(C_2H_4)''Cl_2$	ethylenedichlorodiure, or ethylenedichlorure.
Tribromide of glyceryl	$(C_3H_5)'''Br_3$	glyceryltribromotriure, or glyceryltribromure.
Chloride of acetyl	C_2H_3OCl	acetylchlorure.
Dichloride of succinyl	$(C_4H_4O_2)''Cl_2$	succinyldichlorodiure, or succinyldichlorure, &c.

The water type includes the oxides, sulphides, selenides, tellurides, oxy salts, sulphur salts, &c. The most convenient termination for this series is probably *ide*, as the terms oxide and sulphide are so familiar. If this termination were employed for the hydrogen derivatives, we should be compelled to look for a different termination for this type. The termination *ate* might be used, but I think it would scarcely be so appropriate.

Water	$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	dihydroxide.

Sulphuretted hydrogen $\left.\begin{matrix}H\\H\end{matrix}\right\}S$ dihydrosulphide.

As seldom to be used as oxide and sulphide of hydrogen.

Hydrate of potassium $\left.\begin{matrix}K\\H\end{matrix}\right\}O$ potassiohydroxide.

Sulphhydrate of potassium $\left.\begin{matrix}K\\H\end{matrix}\right\}S$ potassiohydrosulphide

Hydrogen being as much a radical as potassium, deserves to be represented in the name of the compounds of which it forms a part.

Oxide of potassium $\left.\begin{matrix}K\\K\end{matrix}\right\}O$ dipotassio-oxide.

Sulphide of potassium $\left.\begin{matrix}K\\K\end{matrix}\right\}S$ dipotassio-sulphide.

Oxide of platinum $Pt''O$ platinico-oxide.

Hydrate of platinum $\left.\begin{matrix}Pt''\\H_2\end{matrix}\right\}O_2$ platinico-dihydrodioxide.

Oxide of bismuth $\left.\begin{matrix}Bi'''\\Bi'''\end{matrix}\right\}O_3$ dibismuthotrioxide.

Hydrate of bismuth $\left.\begin{matrix}Bi'''\\H_3\end{matrix}\right\}O_3$ bismutho-trihydrotrioxide.

Alcohol $\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O$ ethylhydroxide.

Ether $\left.\begin{matrix}C_2H_5\\C_2H_5\end{matrix}\right\}O$ diethyloxide.

Glycol $\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2$ ethylenedihydrodioxide.

Oxide of ethylene $(C_2H_4)''O$ ethyleneoxide.

Glycerine $\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3$ glyceryltrihydrotrioxide.

$\left.\begin{matrix}(C_3H_5)'''\\(C_3H_5)'''\end{matrix}\right\}O_3$ glyceryltrioxide.

Hypochlorous acid $\left.\begin{matrix}H\\Cl\end{matrix}\right\}O$ hydrochloroxide.

Chloric acid $\left.\begin{matrix}H\\ClO_2\end{matrix}\right\}O$ hydrochloryloxide.

Sulphuric acid $\left.\begin{matrix}H_2\\(SO_2)''\end{matrix}\right\}O_2$ dihydrosulphuryldioxide.

Phosphoric acid $\left.\begin{matrix}H_3\\(PO)'''\end{matrix}\right\}O_3$ trihydrophosphoryltrioxide.

To distinguish between a hydrated acid and a hydrated base, both in the notation and nomenclature, it would perhaps be well to place the hydrogen before the radical in the former case and after it in the latter; thus:—

Hypochlorous acid $\left.\begin{matrix}H\\Cl\end{matrix}\right\}O$ hydrochloroxide.

Hydrate of potassium $\left.\begin{matrix}K\\H\end{matrix}\right\}O$ potassiohydroxide.

The nomenclature of the anhydrides is of course similar to that of the anhydrous oxide.

Hypochlorous anhydride $\left.\begin{matrix}Cl\\Cl\end{matrix}\right\}O$ dichloroxide.

Chloric anhydride $\left.\begin{matrix}ClO_2\\ClO_2\end{matrix}\right\}O$ dichloryloxide.

Sulphuric anhydride $(SO_2)''O$ sulphuryloxide.

Phosphoric anhydride $\left.\begin{matrix}(PO)'''\\(PO)'''\end{matrix}\right\}O_3$ diphosphoryltrioxide.

Acetic acid $\left.\begin{matrix}H\\C_2H_3O\end{matrix}\right\}O$ hydroacetyloxide.

Acetic anhydride $\left.\begin{matrix}C_2H_3O\\C_2H_3O\end{matrix}\right\}O$ diacetyloxide.

Succinic acid $\left.\begin{matrix}H_2\\(C_4H_4O_2)''\end{matrix}\right\}O_2$ dihydrosuccinyldioxide.

Succinic anhydride $(C_4H_4O_2)''O$ succinyloxide.

Citric acid $\left.\begin{matrix}H_3\\(C_6H_5O_3)'''\end{matrix}\right\}O_3$ trihydrocitryltrioxide.

Citric anhydride $\left.\begin{matrix}(C_6H_5O_3)'''\\(C_6H_5O_3)'''\end{matrix}\right\}O_3$ dicitryltrioxide.

The sulphur acids and salts of course follow the same rules,

Sulphocarbonic acid $\left.\begin{matrix}H_2\\(CS)''\end{matrix}\right\}S_2$ dihydrosulphocarbonyldisulphide.

Sulphocarbonic anhydride $(CS)''S$ sulphocarbonylsulphide.

The nomenclature of the salts is obvious.

Acetate of silver $\left.\begin{matrix}Ag\\C_2H_3O\end{matrix}\right\}O$ argentoacetyloxide.

Primary sulphate of potassium $\left.\begin{matrix}K\\H\\(SO_2)''\end{matrix}\right\}O_2$ potassiohydrosulphuryldioxide.

We have now only to mention the last type, H_4C. There are only few derivatives of this type, but names must be in readiness for these compounds when discovered. The termination *uret* may be applicable in this case.

Marsh gas H_4C tetrahydrocarburet.

Siliciuretted hydrogen H_4Si tetrahydrosiliciuret.

I know that there are very many weak points in the system that I have taken the liberty of describing, and that it will be very much ridiculed. One of the greatest difficulties is to find appropriate names for the different radicals. I have tried once or twice to concoct some terms, but they became so barbarous that I abandoned the attempt. However, we have the names of the radicals of the fatty alcohols, if we like to employ them,—I mean the nomenclature of these bodies used by Gerhardt,—viz.: trityl, tetryl, &c.; we might have monyl, or eisyl, and deutyl, but they would not replace the names methyl and ethyl, for some time at least. There is, unfortunately, too little, and yet too much, distinction between the alcohol and acid radicals; too little in the fact that they all end in *yl*, and too much, as we do not see the relation between the radicals of the same series. We see no relation between ethyl and acetyl by the name; and if we adopt Professor Williamson's suggestion, and call acetyl othyl, then we must have omethyl, opropyl, &c. Perhaps, if the termination *oyl* were employed for the name of the acid radical, it might have some benefit; however, in this case, the similarity might be too great: thus—methyl methoyl, ethyl ethoyl, bear a great resemblance to one another. There would be a confusion in the case of caproyl and capryl, but that would not be new.

In conclusion, I have only to apologize for having written at such length; but if you should think these remarks worth admission to your Journal, they might be the means of directing others who are more competent for the task than I am to propose some systematic nomenclature which would be of lasting benefit to our science.—I am, &c.

Herbert McLeod.

London, December 4.

To the Editor of the Chemical News.

Sir,—Will Mr. Newlands be kind enough to say what will be the name for albumen according to his proposed new system of nomenclature?—I am, &c.

Inquirer.

Bath for High Temperatures.

To the Editor of the Chemical News.

Sir,—Some time ago, having occasion to use a bath capable of affording a temperature considerably above that of boiling water, my friend Mr. Tichborne suggested to me the use of glycerine instead of the ordinary saline baths. I tried a mixture of glycerine and water and found it to answer so well the purpose for which it was intended, that I thought it would be worth while to make known a few particulars which might prove useful to chemists.

I found the boiling-point of a mixture of six parts water with one part glycerine (by measure) to be about 218° F.; with equal parts glycerine and water, 230°; and by using six parts glycerine with two of water, the temperature was raised to, and remained steady at 250°. If the proportion of glycerine be much increased beyond

this point, acrid fumes are given off on heating the mixture.

The glycerine which I used in these experiments, though otherwise pure, had frequently been accidentally exposed to the air, and had doubtless, absorbed some moisture from the atmosphere; therefore, the results given above may be looked upon as correct for the mixtures experimented upon, though perhaps they may not hold good when other samples of glycerine are used.

I am, &c. Emerson Reynolds.

Estimating the Value of Aniline.

To the Editor of the Chemical News.

Sir,—Can any of your Correspondents inform me of any quick and sure method of estimating the value of aniline, and the amount of any one of its homologues present in a mixture of them? Precipitation of the platinum salt and calcination does not give all that is required; and to form a certain quantity of colour and test the amount produced is only approximative, and by rectifying at boiling points many errors may creep in.—I am, &c.

Benzol.

On the Adulteration of Butter.

To the Editor of the Chemical News.

Sir,—Before proceeding to the detail of another test for the presence of fats in butter, I feel that the note of Mr. Horsley in the last Number of the Chemical News calls for a brief remark. So far from wishing to "condemn" the utility of the ether test, I think that we are all indebted to Mr. Horsley for publishing it; and I am willing to acknowledge and announce that he has been the first to make public any test at all by which this adulteration is to be discovered. I agree with him that ether does detect lard when mixed with butter in small proportions very readily and satisfactorily, but not exactly when used in the manner he details. I think, as he describes its use, the appearance of the deposit may have misled him, and induced him to think that lard is the common adulterant. It may so happen, too, that the "fresh" butter I have examined in London may really be adulterated with a different substance to the butter which he has analysed in Cheltenham.

Again, I think Mr. Horsley has misunderstood me when he says that the ether test can readily identify other kinds of fat than lard, while those I have put forward will not detect any but beef dripping. I don't think I stated this. On the contrary, the peculiarities of both mutton fat or dripping—for I have used the terms "fat" and "dripping" synonymously—and of lard come out as remarkably as those of beef fat on melting with boiling water in a beaker, &c., as I propose showing in my next paper. I do not desire to disparage the use of ether, but still it appears to me that a service is rendered if it is shown that what everybody has at hand suffices to detect these substances in butter. I am sure Mr. Horsley is equally desirous with myself to arrive at the truth; and with this view, as I shall always be pleased with any criticism that he may bestow upon my observations, I hope, in all friendliness, he will not object to my criticising his.

I am, &c. Edward Ballard, M.D.

Parochial Laboratory, Islington, December 9.

MISCELLANEOUS.

Sulphur in California.—The refining of sulphur has been commenced as a business in Santa Barbara county, Cal. Twenty miles south-eastward of the town of Santa Barbara, and seven miles back from the Mission of San Buenaventura, which is upon the sea shore, is a great bed of native sulphur, deposited in remote ages by the vapors and waters of sulphur springs. The country in the vicinity bears strong marks of volcanic action. The sulphur deposits back of San Buenaventura have long been known, but only lately has it been rendered valuable. Messrs. Davidson, Spence & Co. commenced about the first of this year to open the mine. The *Daily Alta* says, that there were then some half a dozen men at work in the mine, and this sulphur is so abundant and accessible, that the time is perhaps not far distant when it will be shipped to Europe. The crude deposit is stated to comprise 80 per cent. of sulphur.—*Scientific American.*

Chemical Society.—The next meeting of this Society will take place on Thursday evening next at Burlington House, at eight p.m., when the following papers will be read:—Dr. Bence Jones, "On the Simultaneous Variations of Hippuric and Uric Acids in Healthy Human Urine;" Mr. G. F. Rodwell, "On the Solubility of Sulphate of Lead in Hydrochloric and Nitric Acids."

Taking Notes of Lectures.—There is one cause especially which I believe has tended to depreciate the value of lectures as a means of instruction. It is the common practice which students fall into, of taking very copious notes whilst in attendance upon them. This is a great mistake, for if a student during a lecture have his eye constantly directed upon the paper on which he is simply recording the words of the lecturer, instead of directing his principal attention to the lecturer himself and the illustrations which he is employing, he necessarily loses in a great measure the effect which must be otherwise produced by the words as they flow from the earnest and high-minded teacher; and at the same time he will gain but an imperfect acquaintance with the details and mode in which experiments have been performed, or of the nature of the specimens exhibited for the elucidation and demonstration of the subject-matter of the discourse; and hence the advantages he would otherwise derive from attendance upon lectures over those of simple reading, are, in a great measure, lost. My advice to a student, therefore, is, to take notes only of the "heads" of the lecture, or at least, not to allow note-taking to interfere with his attention to the lecturer, and afterwards whilst the lecturer with his apparatus and specimens are photographed as it were in his memory, to fill in the details by reading and thinking over what he has heard.—*Professor Bentley.*

ANSWERS TO CORRESPONDENTS.

C. G.—It has not yet been mentioned in our pages. We will bear it in mind.

Treatment of Tar.—*W.* writes, Where can I get good information as to the treatment of tar, and refuse from gas works, the method of making naphtha, paraffin, and dyes from tar, &c.?

Ignoramus.—In inhaling air containing carbonic acid, a large quantity is taken into the lungs, where it comes in contact with the blood. But in drinking aërated beverages, a small quantity only is taken into the stomach. The action of an agent in one instance has nothing to do with its effect in the other case.

Browning for Gun Barrels.—*Armourer.*—Take tincture of perchloride of iron ½ oz., spirit of nitric ether ½ oz., sulphate of copper 2 scruples, distilled or rain water ½ pint. Clean the barrel with lime and water, and apply with a sponge. When dry, polish with a stiff brush or iron scratch brush.

G. C. C.—1. Sulphite of soda is made by passing sulphurous acid into caustic soda; sulphide of sodium, by passing sulphuretted hydrogen into the same alkali. Which do you mean? 2. Your question would require a long explanation in answer; read some elementary work on Physics and Meteorology.

Filtering-Paper—Our opinion has been asked respecting a kind of filtering-paper, supplied by Wilcox and Co., advertised as "chemically pure, and the cheapest ever made." It is of a whity brown colour and upon burning leaves a reddish brown ash. Four sheets 7½ inches in diameter were found to yield, upon combustion, 0·694 grains of ash. This is much less than that yielded by ordinary white filtering paper, at even a higher price, although it is nearly double that left by the best Swedish paper. The paper, when in use, is very strong, and filters quickly, without, at the same time, allowing any of the precipitate to pass through. Taking into consideration the low price at which it is offered, it will be found a very valuable article for general qualitative work, although it is not to be recommended for delicate or quantitative experiments.

Books Received.—"Elementary Treatise on Physics." By Professor A. Ganot. English Edition. Part III. London: H. Baillière. "A Set of Chemical Tables," on six large sheets, arranged by Dr. Galloway. London: John Churchill.

THE CHEMICAL NEWS.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Chemical Researches on the Assay of Silver by the Moist Way, by G. J. MULDER, *Math. Mag. Phil. Nat. Medicinæ, Artis Obstetriciæ et Pharmaceuticæ Doctor, Professor of Chemistry at the University of Utrecht, Grand Cross of the Order of the Netherlands Lion; of the Luxembourg Order of the Couronne de Chene; of the Swedish Orders of Wasa and Polar Star, &c., &c.*

(*Continued from page* 298.)

IT is well known that the temperature exerts in most cases a very great influence on the solubility of substances in liquids; the solubility is hereby often increased. What, now, is the influence of the temperature of the liquid submitted to the assay on the quantity of chloride of silver which remains soluble in the nitrate of soda? The answer to this question is of great importance, as much for the assay experiments as for scientific interest.

I took a solution of one gramme of pure silver, which was first treated at 18° C. with 100 cubic centimètres of salt standard solution, and was further brought to the limit of precipitation with decimal solution of salt, and then treated again with decimal silver solution, and again with decimal solution of salt, the temperature remaining at 18° C. The bottle which contained the liquid was now heated to about 30°, and at that temperature the decimal solution of silver was added unto the limits of precipitability. The temperature was then raised to from 45° to 55°, and at this it was kept or brought to it again previous—that, after strong shaking, a fresh addition of silver or salt solution was added. Finally, it was cooled down to 25°.

The results of these experiments are sufficiently significant to be quoted in full. The drops have been added two by two every time until a perceptible precipitate ceased to make its appearance:—

	Decimal solutions.		
At temperature of 18° C.	22 drops of solution of silver		
„ „ 18° C.	22	„	„ salt
„ „ 30° C. about	35	„	„ silver
From 45° to 55° C.	60	„	„ salt
„ 45° to 55° C.	60	„	„ silver
„ 45° to 55° C.	60	„	„ salt[1]
At temperature of 25° C. about	47	„	„ silver
„ „ 25° C. about	29	„	„ salt

The precipitation has been effected with the greatest care, and has never been carried over the limits; but the influence of the rise and fall of the temperature has occasioned a certain anomaly which was quite unavoidable. When we take the sum of the drops of silver and salt, we have:—

Silver.	Salt.
164 drops, or 8·2 c.c.	171 drops, or 8·6 c.c.

This agrees so closely that we may declare the result a good one. The experiment remained the same at the end as in the beginning, and if it had been carried again up to 18° C. the required quantity of 22 drops would have made its appearance again; but the risk of discolouration of the chloride of silver prevented the longer continuation of the experiment. The main point is this, that at a temperature of from 45° to 55° the quantity of chloride of silver dissolved in 0·787 grammes of nitrate of soda and 100 cubic centimètres of water is almost three times as large as at 18° C. We have already learned that the silver which remains this way in solution when the assay is made with 1 gramme of pure silver and 100 cubic centimètres of standard solution, weighs 1 milligramme, the temperature being at from 15° to 17°. Without anything else being changed, the increase of temperature (45°—55° C.) increases the weight of silver dissolved three times—*i.e.*, 3 milligrammes remain in solution. A decrease of temperature has just the opposite effect, as the following experiment will show:—

One gramme of pure silver was first dissolved in 5 cubic centimètres of nitric acid, then precipitated at a temperature of from 15° to 17° C. with 100 cubic centimètres of standard salt solution, and afterwards cooled to 5° C., and treated first with decimal solution of salt and *vice versa* with silver and salt (decimal solutions), the mutual precipitate was produced, the temperature being kept at 5° C. The results were the following:—

Silver.	Salt.
A 13 drops	B 13 drops
C 13 drops	D 13 drops

At a temperature of 5° C. 13 drops only of the solutions of silver and salt were required to produce the mutual precipitate unto the ultimate limit: 13 drops = 0·65 milligrammes of silver, or its equivalent proportion of salt. We have, therefore, the following series: 0·787 grammes of nitrate of soda and 100 cubic centimètres of water dissolve—

	Chloride of silver or silver. Weight in milligrammes.	
	Cl. Ag.	Ag.
At 5° C.	0·86	0·65
At 15°—17° C. . . .	1·33	1·0
At 45°—55° C. . . .	3·99	3·0

Two other points deserve our attention: viz., the influence of and excess of free nitric acid, and the influence of nitrate of copper on the origin of the mutual precipitate. The former—*i.e.*, excess of free nitric acid—occurs in the ordinary assay of pure silver, while the former again with the latter are met with in the assays of alloys of silver and copper. The quantity of nitric acid and its strength, degree of concentration, are not very strictly taken when an assay is made, while the quantity of copper in the alloys is subject to much variation, and the quantity of nitrate of copper must consequently vary also; and if these two agents, nitric acid and

[1] It deserves to be noticed that at this temperature the precipitate as soon as formed gets immediately dissolved, as long, at least, as 40 drops have not been fully added; and it requires a very experienced eye to distinguish the precipitate properly.

nitrate of copper, have any influence, then it is necessary to ascertain the quantity and quality of that influence. The following experiments were made:—

a. 1 gramme of pure silver was dissolved in 5 cubic centimètres of nitric acid.

b. 1 gramme of pure silver was dissolved in 10 cubic centimètres of nitric acid.

c. 1 gramme of pure silver and 1 gramme of pure copper were dissolved in 7·5 cubic centimètres of nitric acid.

These solutions were precipitated with 100 cubic centimètres of standard salt solution, and were afterwards treated with decimal solution of salt, so as to bring them to the utmost limit[2]; temperature—16·5° C.

We have further determined the quantity of silver required in order to reduce the precipitate produced by decimal solution of silver to the ultimate limit. The following quantities of decimal solution of silver were required at 16·5° C.:—

For *a*	20 drops
For *b*	22 drops
For *c*	20 drops

This result agrees so closely with that we have obtained for pure silver (see page 204 Vol. IV. No. 98) that we have every right to conclude that, provided the temperature of the vessels in which the assay liquids under experiment are kept remain constant, much nitric acid or much copper exert no influence upon the origin of the mutual precipitate. It is true the experiment was not carried on so as to precipitate again with decimal solution of salt and again with decimal solution of silver; but this was not necessary, for what has been once well observed remains constantly the same under the same circumstances. We have already learned that chloride of silver is more or less soluble in nitric acid, indifferently, whether it be more or less concentrated. Chloride of silver is also soluble in nitrate of silver, but it is so sparingly so that it is of no influence on the silver assays. From what has been treated here we may draw the following conclusions:—

That there are sources of errors in the method of assay by the wet way, even if pure silver be used, which errors depend, first, on the quantity of nitrate of soda; secondly, on the quantity of water; and, thirdly, on the temperature.

It is necessary, and I found it to have a great practical influence, to inquire more accurately into some of these particulars. The quantity of water, it is true, may differ about from two to three cubic centimètres. That difference has not been proved to me to exert any very decided influence upon the assays and experiments connected therewith; but the quantity of nitrate of soda may differ, if care be not taken to employ, when experimenting upon alloys, not from 1000 milligrammes of the alloy, but from 1000 milligrammes of pure silver present in the alloy, in order to secure always the presence of 0·787 gramme of nitrate of soda in the liquid. For instance, let the alloy to be tested be at $\frac{775}{1000}$ths, it is then necessary to weigh according to this equation, 775 : 1000 = 1000 : x, which gives $x = 1{\cdot}2903$ in that quantity 1000 of silver occurs, and 1000 of silver will always yield exactly the constant quantity of nitrate of soda.

It will be said, that this is done merely because the pipette usually employed is filled with 100 cubic centimètres of the standard solution. I say it must be done, not because the same pipette is used, but because every other quantity of nitrate of soda in the liquid gives rise to different results, if, at least, the experiment be carried so far as to precipitate with salt unto the limit of precipitability. It fortunately so happens that not many substances do exert such a disturbing influence as nitrate of soda exerts in these experiments. The following experiments may elucidate this point:—I made an assay experiment to which I will have to refer afterwards again, in which, with one gramme of pure silver, 0·5 gramme of sulphate of protoxide of manganese, 0·4 gramme of cadmium, 0·1 gramme of iron, and 0·5 gramme of zinc—the three latter in a metallic state, were dissolved in nitric acid at the end of the experiment—I applied decimal silver solution unto the limit, the temperature being 16° C. I repeated the experiment with 1 gramme of pure silver and 0·6 gramme of sulphate of nickel, also with 1 gramme of pure silver and 0·1 gramme of oxalate of cobalt. The nitrates of these metals had no perceptible influence on the quantity of silver required, after the decimal solution of salt had been used to precipitate to the limit. To come again to the limit of precipitability these quantities were the following:—

Pure silver	20 drops
Ditto	20 „
Manganese, iron, cadmium, zinc	20 „
Nickel	20 „
Cobalt	20 „

No trace even of influence of the presence of the nitrates of all these metals can be observed to act upon the solubility of the chloride of silver; and though we do not mean to deny that they (*i. e.*, these nitrates) may exert some influence, it is beyond the limits of our experimental observation and of no consequence to the assays.

It is different with the nitrates of the alkalies and alkaline earths, which we will treat of afterwards, when we discuss the equivalent weights of silver and common salt.

(To be continued.)

[2] This expression *utmost limit* is a short expression for the one we so frequently require to use—viz., utmost or ultimate limit of precipitability.

On the Adulteration of Butter with Animal Fats, by Edward Ballard, *M.D. Lond., M.R.C.P., Medical Officer of Health for Islington, and Parochial Analyst under the Adulteration of Food Act.*

[second communication.]

In the short paper which I took the liberty to send a few weeks ago for insertion in the Chemical News, I ventured to enumerate certain physical indications of the existence of fatty adulterations in butter. I do not pretend to assert that all of them are of equal value. The colour, for example, of true butter will vary with season, with the nature of the feed of the cows, and probably, also, with their state of health. And the pressure-test also may vary with a variety of circumstances; but of those I mentioned, there are three which are, I believe, always to be relied upon. These are, the size of the drops which rise when the butter is melted and well stirred circularly with boiling water, and the consequent fineness or coarseness of the resulting appearances of cellulation; the granulation or sago-like appearance of the butter when the cold cake is removed in the adulterated butter, the globules sometimes being as large or larger than the largest grains of sago; and, lastly, the taste of the dried butter. The latter, I believe, is especially to be relied upon. It must be a very small adulteration indeed that will not now be detected by the palate; and these indications I have recapitulated are

not confined to adulterations with beef fat or dripping, as I have been misunderstood to assert. The same phenomena are observed when mutton-fat or lard are the adulterants; and in these cases not only is there a similar appearance in the melted layer and in the granulations, but the taste detects severally mutton fat, from its more tallowy flavour, especially if it have been melted down for some time, and lard from the very distinctive impression it makes upon the palate. I do not think any mistake can occur. I mentioned as an instance the adulteration with an equal weight of beef dripping; but a fourth part of fat, beef, mutton,or lard, gives similar indications, and very markedly too,—quite unmistakeably.

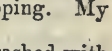
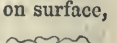
As to the question whether lard or beef or mutton fat is the most common adulterant. There are parties in London whose sole business it is to deal with the butchers and others in fat. Among these I have had inquiries instituted. It appears that the destination of it is as follows:—The persons to whom it is sold first of all very carefully pick out every bit of pork fat, however small, and it is purchased by pastrycooks and chemists, both of whom find it to their advantage to prepare their own lard. The beef and mutton fat go to the melters, who select the suitable and best bits, which they boil down and pack in casks for parties at Ostend and other places, for the undisguised purpose of mixing with butter. There is no secret in this among persons engaged in the trade. The rest is prepared for the soap-boilers and others. I am further informed that for the preparation of butter beef fat is preferred. A few years ago there was, however, such a scarcity of fat, at Ostend that mutton fat, &c., were taken indiscriminately.

And now for the ether test, as put forward by Mr. Horsley. Since the publication of his letter I have made some experiments respecting it, the result of which I may as well detail before proceeding further. Mr. Horsley's statements are, that, first, pure butter ought entirely to dissolve when covered with ether at 65°; second, that the purest lard is more or less insoluble under similar circumstances, and that the same may be said of dripping, mutton suet, tallow, &c.; and, third, he distinguishes these several substances by the appearance of the precipitates, stating that that from lard is very fine and smooth, whilst that from dripping is granular and crystalline, and that from tallow long and thread-like, laying piled up one above the other. In my own experiments I used an apparatus which enabled me to weigh the precipitate, as well as to observe its character during the solution; and I used a constant quantity of the butter or fat to be tested, and a definite quantity of ether. In this way I hoped to attain more precise results. The difficulty I had to contend against was that of collecting and weighing the deposit without risking the loss of ether by evaporation, and the deposition of some of the dissolved-out matters by lowered temperature during the operation. The expedient I hit upon was this:—I take an ordinary test-tube, about 4½ inches long and about one inch wide, and fit it as accurately as possible with a good cork. I then take a piece of thin glass tube about ⅖ths or ½ an inch diameter, and from 1½ to 2 inches long—pieces of broken test-tubes do very well—and turn over the edges, so as to form a lip at each end. Over one end I tie with thread, tightly stretched, a little bit of thin linen rag, and round the tube beneath the other lip another piece of thread, leaving one end long. This, with a water-bath, constitutes my apparatus. In each experiment I used 20 grains of butter or fat to be tested, which I weigh in the cylinder, and then let the latter down into the test-tube by the thread. I pour in the ether, directing it into the cylinder, and the thread hanging out of the tube. I put in the cork firmly and tie over with a leather cap. The tube is then immersed in the water-bath, at 65°, and at the expiration of an hour—this being the time I have mostly allowed for solution—the cap is removed, the cylinder drawn up by the thread without the necessity of removing the cork, the cap put on again, and the cylinder left for the ether to drain off from the deposit, the temperature of the bath still being maintained. As soon as the ether appears to have drained away, I remove the cylinder from the tube, and, closing the open end with my finger, press the other end upon a pad of blotting-paper, so as to free the linen and deposit by its imbibition from all remaining ether and soluble matter. When no further stain is imparted to the blotting-paper, I hang the cylinder in the air to dry; and when all smell of ether has passed off, weigh the cylinder and deposit, deducting the weight of the former.

In order to be sure about the matter, I obtained some butter churned specially for me by a friend in Bedfordshire, and with this, which arrived fresh and unsalted, I proceeded to experiment, and I adulterated it as follows:—1, I prepared an adulteration with equal weights of this and strained beef dripping; 2, one with three parts of butter and one of the dripping; 3, one with three parts of butter and one of strained mutton dripping; 4, one of equal parts of butter and pure, home-made, unsalted lard; 5, one of three parts of butter and one part of the lard. I also subjected to experiment separately the lard and beef dripping. My results were as follows:—

The butter and all the mixtures were washed with boiling water, and the cold cake thoroughly dried.

1. *Results of exposure of 20 grains for one hour in the cylinder with one fluid drachm of ether.*

a. Pure butter	Residue 2·4 grains—Residue firm, coherent, smooth, forming a little cupped mass of form represented in the margin; not absolutely white, not smelling of tallow or lard. 
b. Beef dripping	Residue 12·6 grains—A rough looking mass, smelling strongly of tallow.
c. Lard	Residue 12·0 grains—Smooth, very white, smelling of lard.
d. Butter containing an equal weight of beef dripping	Residue 9·0 grains—A rough looking mass, smelling of tallow.
e. Butter containing one-fourth of beef dripping	Residue 4·0 grains—Resembling in shape and appearance that from butter, but whiter, and smelling somewhat of tallow.
f. Butter containing one-fourth of mutton dripping	Residue 4·0 grains—Resembling the preceding.
g. Butter containing one-fourth of lard	Residue 2·0 grains—Residue in shape, when dried, flatter than that from butter or that adulterated with one-fourth of dripping; less smooth on surface, less coherent, and fissured as in  margin, whiter also, more brittle, and not smelling of tallow.

I prepared another sample of this adulteration, and in place of allowing the cake to cool undisturbed, stirred it from time to time, so as to incorporate a little water with it, which is then not separable entirely either by blotting paper or by the desiccator. This powerful physical retention of water in interspaces of the fat is a distinguishing character of lard, and it is imparted to a marked extent to the butter adulterated with it. A specimen thus prepared and dried, as far as it could be, we will mark γ.

γ. Butter with one-fourth lard — Residue 1·8 grains—Forming a flat cake upon the linen covering it universally, and fissuring or drying in all directions. Through this deposit the ether drained off very slowly.

2. *Results of exposure of 20 grains for one hour in the cylinder with two fluid drachms of ether.*

a. Pure butter — Residue 1·8 grains—Of same appearance and character as in experiment with 3j., but the mass is thinner. Before separation the residue was suspended in the ether in the form of a coherent flocculence, entangling a few air bubbles. The ether drained away rapidly.

b. Butter containing one-fourth part of beef dripping — Residue 1·1 grains—Residue much like that of pure butter. The precipitate before separation was powdery-looking, not so fine as that from lard. Ether drained away quickly.

c. Butter containing one-fourth of lard — Residue 1·1 grains—Residue resembling that from 3j. of ether, but whiter. Before draining it formed a close flocculence in the ether. Ether drained away quickly.

γ. Butter with one-fourth lard — Residue 0·9 grains—Residue very white, but resembling that from 3j. ether. Before draining it formed a dense, very firm, smooth deposit on linen, and the ether drained away extremely slowly.

A sample of *b*, prepared in a similar manner to γ, also formed a dense deposit on the linen, but the ether drained away more quickly, and the deposit when dry was of the ordinary character, and weighed 1 grain.

The conclusions, I think, which may fairly be drawn are as follows:—

1. A certain portion of butter is insoluble at 65° in ether, used in the moderate quantities which are fitted for the proposed analysis. Perhaps other samples of butter would give even a larger per-centage of residue.

2. The appearance of the deposit as it lies in the ether (3ij.) assists the diagnosis.

3. So also does the slowness with which the ether drains away from that formed from butter adulterated with lard and prepared as γ.

4. The form and appearance of the dried residue as it lies in the cylinder distinguishes butter adulterated with lard on the one hand from pure butter or butter adulterated with beef or mutton fat on the other.

5. The tallowy odour of the residue from butter adulterated with beef or mutton fat distinguishes it from that afforded by pure butter or lard.

6. Not quite half the weight of beef dripping and lard is taken up in the course of an hour by 5j. of ether at 65°. A longer exposure of lard (for several hours) caused all but six grains to be taken up. In each instance much less is taken up than is taken up from butter.

7. The presence of an excess of butter increases the solubility of the fat or lard mixed with it. The residue from the adulteration with one-fourth of dripping (beef or mutton) was greater than that from butter whether 3j. or 3ij. of ether were used; but the residue was less than it should have been (by calculation) for the quantity of fat present. In the case of lard, the solubility was so much increased by the butter, that the residue, with 3j. of ether, was absolutely less than that from pure butter, and the colour was so much whiter that one must believe that the presence of the lard promoted the solution of the butter also.

8. When the butter was not in excess, the residue from that adulterated with beef dripping was remarkably large, exceeding that which might be inferred from calculation. I obtained nine grains from the adulteration with an equal proportion of beef fat in two consecutive analyses.

9. So far as the comparative quantity of residue is concerned, nothing is gained from the use of more than one fluid drachm of ether to twenty grains of the butter to be tested. In fact, where 3ij. were used, the residue from the butter adulterated with a fourth of lard or of dripping was actually less than that from pure butter.

Parochial Laboratory, Islington, December 12.

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page* 309.)

Synthesis of Sulphate of Lead.—In nearly all determinations of lead, chemists bring the metal to the state of sulphate, in order to weigh it. After having performed so large a number of delicate analyses, I do not hesitate to declare that there does not exist any which present so many difficulties and uncertainties, even when surrounded with the most minute and fastidious precautions. Berzelius has already remarked the extreme difficulty which is experienced in bringing to a satisfactory conclusion a synthesis of sulphate of lead.

I first attempted to perform these determinations in a refractory glass, but in this manner I obtained the most contradictory results. When it is attempted to heat the sulphate of lead the glass is attacked even before the excess of sulphuric acid is entirely driven off. It is, therefore, indispensable to perform the operation in platinum vessels. These are the arrangements which I eventually adopted:—

So as to save the labour—more considerable than would be supposed—of preparing the quantities of lead necessary to determinations of this kind, I combined some of the syntheses of nitrate of lead with those of the sulphate of this metal. Thus, the nitrate obtained in the synthesis No. IV. was transformed into sulphate. No. I. in the following Table shows the result. The nitrates produced in the experiments Nos. V., VII., VIII., IX., and X. were likewise converted into sulphates, the results being successively shown in Nos. II., III., IV., V., and VI. I effected this transformation in the fol-

lowing manner:—The nitrate of lead derived from a known weight of lead was dissolved in the smallest possible quantity of pure water, and the solution was poured into the weighed cucurbit of a platinum retort, containing an amount of pure dilute sulphuric acid, a little more than sufficient to transform all the lead into sulphate. After a convenient repose the acid liquid, which had become quite clear, was removed with a pipette and introduced into a very large platinum dish, which had been weighed, together with the platinum retort, and immediately submitted to evaporation over a water-bath, protecting as much as possible the surface from contamination from suspended matters in the air. The glass globe which contained the nitrate was repeatedly washed in pure water. All the washing-waters were added to the cucurbit already containing the sulphate of lead.

A small quantity of sulphuric acid was then poured into the liquid in the cucurbit to be certain that there was no more lead in the state of nitrate. In proportion as the liquid in the dish evaporated I replaced it by a fresh quantity taken from the cucurbit. In order to remove as much as possible the excess of sulphuric acid and all fixed soluble matter, I washed the sulphate two separate times in pure water. All the washing-waters, perfectly cleared by standing, were added to the liquid in the dish and evaporated in their turn. Then I exposed the cucurbit to a steam heat to dry the sulphate of lead. When, under the influence of a temperature of 100°, it disengaged no more vapour whatever, I embedded it deeply in a bath of magnesia, and raised it gradually to dull redness. After the volatilisation of traces of sulphuric acid, I saw appear in all my experiments nitrous vapours. As these vapours might be derived from the presence of some traces of nitrate of lead carried down by the sulphate in each experiment and after the vessel was cool, I moistened the salt with water very slightly acidulated with pure sulphuric acid. I again dried the mass over the water-bath, and calcined the sulphate a second time by heating the vessel in a magnesia bath. I never, in this second calcination, saw red vapours appear.

In all my experiments the sulphate of lead was of a dazzling whiteness Its desiccation was effected with such care that the side of the cucurbit did not show any trace of projection.

To preserve the sulphate of lead during its cooling from atmospheric moisture, I suspended in the interior of the cucurbit a vessel containing chloride of calcium. This vessel was attached to a glass rod passing through the neck of the moveable head. The opening of the neck was besides closed with a cork.

I now return to the washing waters of the sulphate of lead. The platinum dish which contained them was kept on the water bath as long as its contents disengaged vapours. After all the liquid capable of volatilising at 100° was dissipated, I covered the platinum dish with a porcelain capsule larger than it, and having a hole bored in its upper part. Through the hole in the capsule I passed a glass tube nearly down to the surface of the liquid residue contained in the platinum dish. I then disengaged pure ammonia to transform the sulphuric and nitric acid which the dish contained into sulphate and nitrate. When the mass was almost solidified, I placed the dish in a bath of magnesia and heated it very gently to redness. Towards 300° the sulphate of ammonia decomposes into volatile products, and the capsule contains absolutely nothing but the sulphate of lead mixed with the traces of foreign matters existing in the lead or the sulphuric acid. To eliminate the soluble sulphates which the sulphate of lead in the capsule could contain, I always wash the salt in water very slightly acidulated with sulphuric acid. After the washing and drying, I calcined a second time the small quantity of sulphate thus obtained.

In the first two determinations which I made, I had the misfortune to throw away the washing waters. I am therefore ignorant whether they contained any fixed product. In the four following I evaporated them down in a weighed platinum dish. The residue which I heated to redness weighed:—

In No. III. . .	0·0140	grammes, consisting of alkaline sulphates with traces of iron and copper.
In No. IV. . .	0.0193	do.
In No. V. . .	0·0190	do.
In No. VI. . .	0·0205	do.

These alkaline sulphates were evidently derived from the potassium and the sodium contained in the lead employed. I ought to add that the little sulphate of lead obtained from the evaporation of the washing waters was not absolutely white, even after having been a second time calcined with a mixture of sulphuric and nitric acid. It had a grey tinge.

After cooling for five hours free from moist air, the retort and the platinum dish were both weighed together in the large balance.

Before giving the result of these laborious experiments, I ought to point out a cause of error which I overlooked. I weighed the sulphate of lead in air; but this salt can condense so large a quantity of air as to be sensible with the enormous masses experimented upon. There is a means of ascertaining this fact and correcting the result subsequently if there is really an error of this kind, which would not surprise me.

I have abstained from correcting the weight of the sulphate of lead produced from 100 parts of lead by the weight of the foreign metals obtained in the state of sulphate in the residue of the washing waters of the lead salt, because I consider this correction as being more or less arbitrary, ignorant as I am of the proportion between the potassium and the sodium in these alkaline sulphates. Moreover, the presence in the lead of these excessively minute traces of foreign metals diminishes the weight of the sulphate of lead. The result would therefore be higher if the metal employed had been absolutely pure, and that would remove me still further from the figure, calculated according to Prout's law.

Syntheses of Sulphate of Lead.

Numerical order.	Weight of the Lead in air.	Weight of the Lead reduced to a vacuum.	Weight of the Sulphate of Lead in air.	Weight of the Sulphate of Lead reduced to a vacuum.	Weight of the Sulphate of Lead produced from 100·000 parts of Lead.
	grammes.	grammes.	grammes.	grammes.	
I.	141·999	141·9925	207·9295	207·9388	146·443
II.	148·623	148·016	217·6045	217·6141	146·427
III.	100·007	100·000	146·4125	146·419	146·419
IV.	200·014	200·000	292·850	292·864	146·432
V.	250·0175	250·000	366·0365	366·0525	146·421
VI.	250·0175	250·000	366·041	366·0575	146·423
				Mean ..	146·4275

(To be continued.)

On Alum in Bread and Flour, by John Horsley, *F.C.S. Lond., Analyst to the County of Gloucester.*

The question of alum in bread having often proved a knotty point, and many errors having been made by mistaking other earthy precipitates for alumina, because a white precipitate was obtained on the addition of ammonia to the water in which bread had been soaked, as well as a similar precipitate by the use of either nitrate of baryta, or chloride of barium, the latter being supposed to have reference to the sulphuric acid of the alum salt, when, in fact, it may be due to the sulphate of lime existing in the water which was incorporated with the flour in making the loaf, or to the hard water in which the bread was soaked, I have drawn up the following paper, which contains *in extenso* the precise mode of manipulation which I am accustomed to follow, and which is of a thoroughly practical and reliable character.

The detection of alum in bread or flour consists of three points—viz., the existence of sulphuric acid, potassa, and alumina. If the two former are found, the latter may also be inferred.

Neither sulphuric acid nor alumina are to be found in incinerated wheat corn or flour, and a minute quantity only of potash obtains in it, and that in the form of a phosphate. An abnormal quantity, therefore, of that alkali, conjoined with sulphuric acid, being found in the water on making a preliminary trial by steeping a portion of the suspected bread in it, forms a satisfactory guide to further operations.

In order to get at these ingredients, we must first burn a thousand or more grains of bread or flour to a cinder in an iron dish or earthenware crucible, powder it finely, and burn it afresh till it be reduced to a small bulk—an operation of several hours; boil this in distilled water for a short time, and decant on to a filter, boil the residue again and again with fresh portions of distilled water till it ceases to produce any reaction on turmeric paper, indicating the entire extraction of the phosphate and sulphate of potash, the amount of liquid required being about 12 or 14 ounces.

By this treatment you will have extracted not only all the sulphuric acid and the potash—two of the aforesaid elements of baker's alum—but whatever common salt had been used. By concentration, if necessary, of this liquor, freely acidifying it with nitric acid, and then treating it with nitrate of baryta solution, the sulphuric may be precipitated and the sulphate of potash converted into nitrate of potash. The chlorine likewise may be separated from the common salt by nitrate of silver forming nitrate of soda and chloride of silver. The liquor filtered from the last precipitate should now be evaporated to dryness, and the joint weight of both nitrates taken. These being re-dissolved in water and treated with bichloride of platinum, the resulting dry precipitate determines the amount of potash as well as the soda remaining in solution.

The alumina, the only remaining ingredient left behind in the charcoal as an insoluble phosphate, can be extracted by digesting the charcoal first in cold nitro-hydrochloric acid diluted with a little water, and allowing it to stand a few hours; then boiling, filtering, and washing out all soluble matter with distilled water till ammonia ceases to produce any precipitate. Evaporate the filtrate and mixed washings to absolute dryness over a water bath, when we obtain as a residuum chloride of calcium and chloride of magnesium, with peroxide of iron and phosphate of alumina, the latter, owing to the continued heat, having parted with its chlorine. The peculiar white pearly aspect of the dried mixture will at once indicate the presence of alumina, which, on the addition of distilled water, separates in flocculi. Project the whole on a filter, and wash the residue from time to time with water until it ceases to precipitate with oxalate of potassa, ammonia, or nitrate of silver. Reserving the residue on the filter, we proceed to precipitate, if required, the lime from the filtrate by oxalate of potassa in slight excess, followed by the addition of a little acetic acid, filtering, and evaporating the clear liquor to dryness, incinerating and digesting the residue in distilled water, when carbonate of magnesia and a little oxide of iron precipitate.

The precipitate of iron and phosphate of alumina previously obtained should now be treated with a boiling solution of pure caustic potash, which separates the alumina from the insoluble oxide of iron—sometimes a white precipitate of phosphate of iron may be obtained without any alumina existing—filter, freely acidulate with hydrochloric acid, add ammonia in excess, and boil, when the alumina will be thrown down, mixed with some phosphoric acid, to remove which it may be redissolved in hydrochloric acid, diluted with distilled water, carbonate of potash added in excess to precipitate the alumina, and then taking it up again by the careful addition of more hydrochloric acid till the liquid is clear. Now add a tolerable quantity of a solution of tannin, followed by q. s. of a solution of carbonate of potash, not to neutralise the tannic, but the hydrochloric acid, which, by the precipitation of the tannin with the alumina, becomes too free. This must be kept in check or the tannate of alumina cannot fall. By carefully operating in this way, first with tannin and hydrochloric acid and then with q. s. of solution of carbonate of potash, the whole of the alumina may be extracted, and on evaporating the residuary liquor to dryness and incinerating the salt obtained, it will be found to consist of phosphate of potash and chloride of potassium. The dried tannate of alumina should now be boiled with a little strong sulphuric acid, so as to charr the organic matter; white fumes will be given off, and after a few minutes distilled water should be added, and the mixture boiled till all the alumina is dissolved. Add caustic potash in excess, then some free hydrochloric acid, and lastly, precipitate the alumina with carbonate of ammonia and boiling. Or instead of tannin, silicic acid may be used for precipitating the alumina, thus: Dissolve the phosphate of alumina in liquor potassæ, dilute with water, and add q. s. of soluble silicate of potassa. A gelatinous silicate of alumina forms, which must be projected on a cloth filter and well washed. Press the residue and collect in an evaporating dish; treat with hydrochloric acid, and evaporate to dryness over a steam bath. The residue being then digested in distilled water, the chloride of aluminum is dissolved out, and the insoluble silica precipitated. On this liquor being filtered, the addition of carbonate of ammonia will, with a slight boil, yield the pure alumina, the whole of the phosphoric acid remaining behind in the filtered liquor as phosphate of ammonia.

As liquor potassæ generally contains traces of alumina, previous experiments should be made on it so as to ascertain the probable amount, for which a deduction or allowance should be made in estimating the alumina extracted from the bread.

County Analyst's Laboratory, Police Station, Cheltenham.

PHARMACY, TOXICOLOGY, &c.

New Process for the Extraction of Quinine and the Estimation of the Alkaloids of the Quinquinas, by M. RABOURDIN.

Extraction of Quinine.—I base this process on the property possessed by fixed caustic alkalies employed in excess to dissolve tannin, insoluble cinchona red, the colouring and resinous matters of quinquinas, without touching the quinine.

My method consists in reducing the bark to powder, and treating it in the cold in a displacement apparatus with water containing three per cent. of hydrochloric acid. I cease pouring in liquid when that which passes has but little taste.

Into the liquid which has passed through, and which amounts to eight or ten times the weight of the bark employed, I pour solution of caustic soda, in quantity about equal in weight to the original bark, and well agitate the whole. The quinine precipitates in white caseous flocks, which settle rapidly; the deep-red supernatant liquid is decanted, and the precipitate collected on a linen filter and washed with a small quantity of water.

Almost entirely composed of quinine, this precipitate may be purified by two methods:—

1. If it is acted on by a quantity of dilute hydrochloric acid insufficient to dissolve the whole of the alkaloid, there is obtained on filtration a colourless solution, which yields with ammonia white and pure quinine.

2. If the precipitate is to be entirely exhausted, a slight excess of acid must be used. In this case there is obtained upon filtration a slightly-coloured liquid, which is bleached in the following manner:—Pour into the hydrochloric solution dilute ammonia until a brown precipitate appears, and upon filtration a colourless liquid is obtained. If, in consequence of the addition of an excess of ammonia, white flocks appear mixed with the brown precipitate, acidulated water must be added until these are dissolved. Ammonia precipitates quinine from the clear and colourless filtrate. In this state it is perfectly white, and only contains traces of cinchonine.

This process appears to me to introduce great economy in the manufacture of salts of quinine,—first, by suppressing the employment of alcohol as a solvent; and second, by avoiding the precipitation of the quinine by lime, and, consequently, the drying of this calcareous precipitate by artificial heat; third, by suppressing the employment of animal black as a decolorising agent; and, fourth, I may affirm, by yielding a more abundant product; for, indeed, this method permits me to obtain so readily the whole quantity of alkaloid contained in quinquinas that I propose it as a means of estimating the value of barks in commerce. The three officinal quinquinas are equally well treated by this method. When I wish to estimate gray bark I take forty grammes, but only ten grammes in the case of the Calissaya and red barks.

Mode of Assay.—I take ten grammes of Calissaya quinquina in fine powder, and moisten it with water acidulated with four per cent. of hydrochloric acid. The powder is then arranged uniformly in a long tube, provided with a plug of cotton, and exhausted with the same acidulated water with which it was moistened. If the displacement takes place with regularity, and no local caking together of the powder takes place, it is exhausted when there are obtained between 100 and 120 grammes of filtrate. Into this liquid there are then poured twelve to fifteen grammes of caustic soda solution, which is well mixed by agitation. The precipitate is then collected on a filter and washed with a little water as long as any red liquid passes through.

When the filter has well drained it is removed from the funnel, placed in a dish, and moistened with very dilute hydrochloric acid, so that there is a slight excess of the latter. When solution has taken place, the paper is squeezed out with a glass rod and the liquid poured into a small filter. The paper which has been squeezed is washed twice with water, which is afterwards used to wash the second filter. There is thus obtained a liquid slightly coloured of a reddish-yellow, which is decolorised in the manner indicated above,—that is to say, by adding dilute ammonia until a white cloud begins to appear. If this latter does not disappear on agitation, a few drops of acidulated water are poured in, so as to keep the precipitate of a dark red colour. It is then to be filtered, the filter washed with a little distilled water, and ammonia poured into the clear and colourless liquid, so as to precipitate the quinine. This latter is collected on a paper filter, washed with distilled water, and dried in the air. When dry it is easily detached from the paper. The weight is then taken, which shows the richness of the bark.

Ten grammes of dull Calissaya quinquina should yield 30 to 32 centigrammes of white quinine, containing a very small quantity of cinchonine, which may be isolated with rectified ether.

Red quinquinas vary much. Whilst some very dense, bright, red barks have yielded me 0·38 grammes of a mixture of quinine and cinchonine from 10 grammes, others of a good appearance have only yielded 0·24 grammes when working on the same quantities.

Gray quinquinas have yielded me 0·10 grammes to 0·20 grammes of cinchonine when operating upon 40 grammes of bark; this gives the proportion between the cinchonine and the bark of 5 to 1000.

I have decided upon the treatment in the cold and by displacement to exhaust the barks because it is the method which has succeeded best with me. Decoction in acidulated water gives a liquid much changed with colouring matters. When caustic soda is added to this, the precipitate remains of a red colour, the filtration takes place with extreme slowness, and less product is finally obtained.

I have exhausted quinquinas with alcohol of various strength. I have added water to the alcoholic liquid, evaporated off the alcohol, and then added caustic soda to the residue. As with the liquids obtained by decoction the precipitate of quinine was mixed with colouring matter, the filtration was difficult and the product less abundant.

I prefer, therefore, the treatment in the cold, which gives real and positive reactions. When a little skill is acquired in this process, the assay of a quinquina will only be found to occupy about an hour's work.—*Journal de Pharmacie et de Chimie.*

On the Deleterious Effect of Light on Potatoes.

THE influence of light on vegetation is now regarded as a matter of the utmost importance, and although the precise mode of action may not be always understood, yet powerful effects of it are everywhere perceptible. In its absence leaves become blanched that would otherwise be green. Roots that are white underground become

green when exposed. Turnips, white beneath, are green or perhaps red above, and many kinds of fruit, naturally pale, colour under bright sunlight. By the action of light on leaves, the different secretions peculiar to plants are formed, such as gum, sugar, starch, oils, and even, in certain kinds of plants, deadly poisons. In some plants, too, the secretions due to the action of light are in certain portions harmless and nutritious, whilst in other parts of the same plant, through the same agency, highly deleterious principles are formed. The potato offers an example. Everybody knows that its tubers contain wholesome food, and it is also generally known that the stems, and especially the apples or seed vessels, are deleterious. But the treatment to which the potato is sometimes subjected is calculated to develope the poisonous quality in the tubers themselves, a change which can only take place during exposure to light. The poison found in the green parts of potatoes is called "solanine." This exists in several species of Solanum, and is found in considerable quantity in the shoots of potatoes. To obtain it the shoots are bruised and acted on by water acidulated with sulphuric acid. It is very poisonous. (Turner's "Elements of Chemistry.") Liebig says it is a powerful poison.

Although the stems of potatoes, according to the authorities just quoted, contain in notable quantity the noxious and easily-extracted principle, so dangerous in its concentrated form, yet the tubers grown underground and kept in the dark are floury and white when cooked, if the variety of potato is good, and quite free from acrid taste, which is one of the characteristics of solanine, and a sure indication of its presence. But the potato tuber is in reality a sort of stem; for it is furnished with buds, which, under favourable circumstances, push into shoots, as buds do on stems above ground. It is therefore, highly susceptible of the influence of light; for although both its skin and flesh are white, they soon become green by exposure; and the continued presence of light renders them as green as stems above ground. It is said that pigs have been killed by giving them potatoes greened to this extent. Such, of course, could not be sold for human food. For this purpose potatoes exposed to light must be housed or otherwise shaded before the green tinge is apparent, at least to the naked eye. But under the impression that the tubers keep better after having well basked in the sun, many cultivators are in the habit of turning them up, and spreading them out on the surface of the ground in bright sunny weather. This has the effect of greatly deteriorating their quality. Notwithstanding disease, really good potatoes can be found; but even slightly diseased ones, with the infected portions cut away, are infinitely better than quantities of others which, though they have a goodly appearance, have been greened. Instead of being white and floury when cooked, they are yellow, and have a disagreeable acrid taste, which can scarcely be disguised, or, if it should, there is no proof that the deleterious effects of the acrid principle are counteracted. At all events, it would certainly be very desirable that such means should be adopted as would prevent that principle being generated, or, in other words, the tubers should be kept as much as possible in the dark instead of exposing them to light. The advantage of exposure as regards better keeping is doubtful, whereas the deterioration it occasions in the quality of the tubers as an article of food is certain. I have thus endeavoured to draw attention to the subject, and it is the duty of every one who is aware of the deleterious effects of light on the potato to explain it to those who are not; for a knowledge of it, if acted upon, would prove beneficial to both rich and poor.—*The Gardener's Chronicle and Agricultural Gazette.*

PHYSICAL SCIENCE.

On Spectrum Analysis, by Dr. K. M. Giltay, *Director of the Société Batave of Rotterdam. (Extract from a Letter to the Abbé Moigno.)*

I READ in the *Cosmos* of September 13, that MM. Bunsen and Kirchhoff are blamed for not having mentioned M. Plucker as their forerunner in spectrum analysis. Not only do I perfectly agree with you, but, in my opinion, this is their least fault. M. Plucker has taken a great step further which they have entirely overlooked, and which is of great consequence in the explanation of these phenomena, perhaps also to the conclusions to be drawn from them.

M. Plucker has proved by vigorous experiments that the spectra of incandescent gases (simple or compound) are formed by luminous bands of an obscure background; that by properly narrowing the slit these bands can always be decomposed into bands of the same width as the slit; that there are no smaller ones[1]; and that consequently these bands are formed by the homogeneous light, of which the index of refraction may be measured by determining that of the centre of the band; and that, strictly speaking, they may be broader than the slit, and the light is then of a continuous refrangibility, between the limits of dispersion of the extreme rays of the band. These larger bands may then form a considerable proportion of the entire spectrum. M. Plucker has measured, not only the index of refraction of these bands, but the length of the wave, so as to render the measurements wholly independent of the prism. In discussing the results, M. Plucker states his opinion that Fraunhofer's lines were not to be compared with these luminous bands, on account of the small diameter of the lines, almost innumerable in the spectrum which Fraunhofer, and after him Baden Powell and Brewster, have produced with a good sized slit. These lines of Fraunhofer's are, then, obscure lines on a luminous background. They are the particular lines wanting in a continuous spectrum. In Plucker's spectra, on the contrary, the bands are of homogeneous light on a dark background. These are the spectra of discontinuous refrangibility.

In their spectrum analyses, MM. Bunsen and Kirchhoff have made no strict measurements. They give the position of the lines only in relation to the solar spectrum by comparing the luminous rays of their spectra with Fraunhofer's obscure lines. I have repeated their experiments, and I can affirm that their conclusions are not a legitimate interpretation of the phenomenon. The luminous bands of different spectra are for the most part bands of homogeneous light, having the same breadth as the slit when they are properly contracted; if enlarged they are superposed. The calcium spectra gives the result admirably. The bands of lithium and potassium

[1] We believe that M. Plucker regards as an exception to the general rule the instance in which in the light examined by the prism there are solid and incandescent particles, which are all drawn in one common direction. The light being near the slit, there should be, besides the spectrum of the light, the spectrum of the minute, infinitely narrow line described by the incandescent particle, and seen across the slit. We adduce, as an example, the magnificent spectrum obtained by the prismatic analysis of the interior of the small flame obtained by burning ordinary lighting gas with the aid of a jet of oxygen gas.

being far apart, either do not give this superposition or give it very imperfectly. But it is chiefly by the aid of these spectra that we can demonstrate that the bands are always the same width as the slit. I repeated these experiments with one of Babinet's goniometers, and with a slit varying from 3′ to 45′. In the calcium, strontium, and barium spectra there are bands somewhat wider than the slit, but, as M. Plucker says, the explanation of this is not difficult. Thus, these bands are not to be compared to Fraunhofer's lines.

So much for the facts; now for the consequences. MM. Bunsen and Kirchhoff have pointed out these spectra, first, as the best, or at least the most sensitive, means of chemical analysis. This is perfectly correct; but M. Plucker has said it before them, and you have proved it. Second, as a means of discovering the elements of the celestial bodies. They start with the law discovered (?) by M. Kirchhoff, that incandescent gases absorb instead of transmitting the rays which they emit. By superposing the solar spectrum, made sufficiently intense, upon the spectra of artificial lights, they found that some of these luminous bands became obscure. These were the bands coinciding (?) with certain lines of Fraunhofer. From this they concluded that the solar atmosphere gives a spectrum the inverse of what it would have given had it been the only luminous body; that this solar atmosphere contains the elements which give these characteristic bands, which become obscure by superposition.

Does not this conclusion require extreme circumspection, since it has not been proved that these luminous bands and Fraunhofer's lines are comparable? In the spectra of MM. Bunsen and Kirchhoff each band is only the length of a wave; each of Fraunhofer's lines, however fine it may be, has an infinity of them. That the luminous band should become obscure, the solar spectrum being superimposed, is very simple, since with a light so intense the rays of an isolated refrangibility, without the neighbouring rays of refrangibility to the right and left, would become very dark.

Allow me to remind you of Forbes' experiments, by which he proved that Fraunhofer's lines do not become darker during a total eclipse—that is to say, when the rays coming from the edge of the sun have to traverse a thicker solar atmosphere. This is, however, what must take place according to the hypothesis of MM. Bunsen and Kirchhoff. This is a little hasty (see your *Optique Moderne*), but it is worth discussing in relation to the other conclusions.

Has it not been observed that Fraunhofer's lines are less obscure at a great height above the level of the sea, and even that some of them are missing? This has caused their absorption to be attributed, at least in part, to our atmosphere.

Finally, one definite substance can perfectly absorb rays of different refrangibilities, as is proved by the spectrum of a luminous ray which has passed through certain gaseous bodies, nitrous acid, iodine, bromine, &c. —*Cosmos*.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

Wednesday, December 4, 1861.

Mr. P. Squire, *President, in the Chair.*

The adjourned discussion on the *Preparation of Extracts* was re-opened by the Chairman, who deprecated any departure from the directions of the Pharmacopœia which the previous discussion might be supposed to justify. He acquitted the compilers of the Pharmacopœia of ignorance. They did not consult the makers of extracts; and the makers did not know that they produced a better article than could have been made if the directions of the Pharmacopœia had been followed. That book was compiled by the highest scientific authorities in the country; but, until now, practical pharmaceutists had not been consulted. A delegate from the Pharmaceutical Society was now, however, assisting in the preparation of the British Pharmacopœia, and pharmaceutists had the opportunity of conveying information to the authors. When, therefore, the work is constructed, it will be the duty of pharmaceutists to implicitly follow its directions. The Chairman then quoted the processes for the preparation of extract of belladonna given in several foreign Pharmacopœias. The French Codex was not quoted, the last edition having appeared twenty-five years ago, and a new one being now in progress. The Prussian Pharmacopœia, used in Germany and Switzerland, ordered the leaves, stem, and flowering branches to be taken, moistened with one-third the weight of water, pressed, strained, and evaporated, filtering at a certain stage to get rid of the chlorophyll. A dry extract was also ordered to be made by taking a certain amount of the moist, drying it, and then mixing sufficient sugar of milk to make up the original weight. The Belgian Pharmacopœia of 1854 directs the flowering herb to be used. The Norwegian Pharmacopœia, published last year, orders the extract to be made from the powdered dried leaves. The process of the American of 1855 is the same as our own. The Chairman then gave a *résumé* of the previous discussion, the tendency of which, he said, was to support the use of all the soft parts of the plant in making the extract.

Professor Redwood said the subject under discussion was a very interesting one as well as of considerable importance. While admitting that at the last meeting (which illness had prevented him from attending) it had been most fully and well discussed, he felt very dissatisfied with the results in two or three respects. In the first place, he thought the general tone of that discussion was to weaken the authority of the Pharmacopœia, and encourage pharmaceutists to deviate from its directions. The Chairman had cleared up this point in his opening speech, and nothing further need be said on that part of the subject. The Professor then called on the Chairman to describe more particularly the parts of the plant used in the preparation of the extract said in the paper to be the strongest and best. Was it really made from stalks, or partly from flower and fruit? From the report of the last meeting it would certainly appear that the stronger extract was made from stalks, and, therefore, the manufacturers would reserve the leaves for purposes to which the stalks were not applicable, and extracts would be made from these and nothing else. The tendency of the foreign Pharmacopœias, the Professor said, was to deviate from the process received as the best in this country, and to reject the albuminous matter and chlorophyll. Extracts made in this way would keep good an indefinite time. Mr. Scanlan had pointed out twenty years ago that the mouldiness of extracts was due to the albumen, take that out and the extract will keep.

The Chairman, in reply, said that no manufacturer would think of using the thick, hard stalks of plants for making extracts, and his paper indicated that large stalks were not to be used. The Pharmacopœia directed the extract of belladonna to be made from leaves only: he had taken the rejected "soft parts," and had prepared an extract which was one-fourth stronger. By "soft parts" he did not mean the thick, hard stalks. His meaning was well given by Mr. Holland in the last discussion, who said he used all the soft parts "which could be easily broken by the hand."

A long conversation followed, in which, however, nothing of novelty or interest was elicited, and the meeting adjourned, the other papers announced being postponed until the next.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 26, 1861.

J. P. Joule, LL.D., *President, in the Chair.*

Mr. Joseph Sidebotham exhibited a photograph of the contorted schists seen in the cliff near the South Stack Lighthouse, Holyhead.

Mr. John Parry showed some photographs of fossil woods from the South Lancashire coal field. These displayed beautifully the structure, even to the most minute vessels.

A Paper was read by Mr. E. W. Binney, F.R.S., Vice-President, entitled "*Additional Observations on the Permian Beds of South Lancashire.*" This was a continuation of two previous papers read before the Society and printed in its Memoirs.[1] Since that time the author had made further observations on the Permian strata at Heaton Norris, near Stockport; Medlock Vale, between Ashton and Manchester; Chorlton-upon-Medlock, and Ordsal, near Manchester; and Skillaw Clough and Bentley Brook, near Newburgh, in the West of Lancashire.

At Heaton Norris, in the sand delf of Mr. Howard, near the railway station, the lower new red sandstone was seen dipping to the south-west at an angle of 25°. This was succeeded by red and variegated marls having a similar dip. These last named strata were overlapped by the Trias, which dips to the south-west at an angle of 12°.

At Heaton Mersey the following section was met with.

	Feet.
Trias.	45
Permian—Red and variegated marls containing limestones	9
Lower new red sandstone grooved	402
	576

The Permian beds were cut off by a fault near the railway station at Heaton Norris, first shown to me by Mr. Hull, B.A., F.G.S., of the Geological Survey, which brought in the Trias. This rock occupied the district between that town and Goyt's Hall, in the Marple valley, where the lower part of the middle coal measures was seen in a nearly vertical position.

The author considered that Mr. Howard's sand delf is a likely place for ascertaining the existence of a coal field under the town of Stockport worth working.

The next was a section made by Mr. John Wood, at Medlock Vale, between Waterhouses, near Ashton-under-Lyne, and Manchester. It was as follows:

	Feet.	In.
Drift	26	0
Trias	23	0
Permian—Red marls, with beds of limestone and five beds of gypsum.	246	3
Lower new red sandstone.	375	11
Coal measures about	90	0
	761	2

What these coal measures were, whether above or under the Bradford Four Feet Mine, it was at present impossible to say; but it was to be hoped that some mine would be met with to enable us to determine the value of the great tract of coal measures lying between Ashton-under-Lyne, Oldham, Middleton, and Manchester. Mr. Wood had done more than any other gentleman to clear up this point, and it was to be desired that he should meet with a good seam of coal, both for his own sake and that of the public.

The third section mentioned was at the sugar works of Messrs. Fryer and Co., in Chester Street, Chorlton-on-Medlock, Manchester. The following beds were there met with.

	Feet.
Trias.	114
Permian—Red marls with limestones	237
Coarse red sandstone with pebbles	45
Coarse red sandstone.	24
Coal measures consisting of red shaly marls and limestones (Ardwick).	126
	546

The limestones in the last named strata contained specimens of *microconchus carbonarius* and scales of *palæoniscus*, which clearly proved them to be similar beds to those of the upper coal field at Ardwick, to which they bear every resemblance in physical character.

The occurrence of coal measures on the south side of the city of Manchester is quite new and of great importance, showing that such strata at places are met with under permian and trias deposits much nearer the surface than was previously suspected, and where the upper rocks gave no evidence of their proximity. The above bore has proved beyond doubt that a band of coal measures lies under the south of Chorlton-on-Medlock, and possibly extends to Heaton Norris, being probably brought up by the great Pendleton fault, which most likely passes through the south of Manchester and joins the fault seen near the railway station at Heaton Norris previously alluded to, and described more fully in the Paper.

In the fourth section, at Ordsal, Messrs. Worrall found the trias beds 460 feet in thickness without going through them. At the bottom of the bore the water became so salt that they discontinued the work, it being no longer fit for dyeing and such like purposes. This is the first instance, to the author's knowledge, where salt water has been met with in the trias near Manchester.

The fifth and sixth sections were at Skillaw Clough and Bentley Brook, to the north of the Newburgh station on the Manchester and Southport Railway. These were some time since discovered by Mr. E. Hull, B.A., F.G.S., of the Geological Survey, and described shortly by that gentleman in the sheet explaining the map of the district. Further particulars were given of the details of both sections, and an analysis of the limestone was produced, which showed it to differ in its chemical characters from the thin ribbon bands found in the permian marls near Manchester, Patricroft, Astly, and Leigh, and was very like the yellow magnesian found at Stank, in Furness, North Lancashire. Probably it might prove to be a different bed, and more like the great central deposit of magnesian limestone of Yorkshire than the thin beds previously alluded to.

MICROSCOPICAL SECTION.

November 18, 1861.

E. W. Binney, *F.R.S., F.G.S., in the Chair.*

Dr. Edward Stephens was elected a member of the Section.

The Secretary read a communication from Mr. Thomas G. Rylands, of Warrington, "*On the Classification of the Diatomaceæ.*" The author desired to call attention to the want of systematic arrangement which characterises this favourite branch of microscopical investigation, and to the necessity of a thorough revision of the entire classification of the natural order. The author presented to the Section two slides to illustrate his arguments. The predominant form of frustules was first named by Dr. Brebisson *Cocconeis lævis*. In 1857 it was published by Mr. Roper (M. I. vol. vi. p. 22) under the provisional name *Coscino-*

[1] Vols. xii. and xiv. (New Series) of the Society's Memoirs.

discus? ovalis; but in consequence of finding on the valves eight to twelve submarginal obtuse processes with tumid bases, quite distinct from the spines or teeth which occur in the Coscinodisceæ, the author considers this species must be placed in the genus Eupodiscus, and may fitly be called Eupodiscus lœvis. The specimens were obtained at Llandudno, in ripples in the sand below mid-water; and the Paper concludes with a description of some peculiarities connected with their sudden disappearance.

Mr. John Watson read a paper "*On certain Scales of some Diurnal Lepidoptera*," in which he recommends a new and careful study of this subject. In some genera peculiar scales, called plumules, have long been known; but examination with the binocular microscope shows that they are not flat like the ordinary scales, but cylindrical and hollow. They have been found only in certain genera (named in the paper) at present, and on the males alone; they possess generic resemblances and specific differences, each species displaying its own distinguishing variety. One of great beauty and novelty, found only on two African butterflies, Pieris Agathina and Pieris Chloris, was described, and some very fine drawings of it, by Mr. Joseph Sidebotham, were exhibited, and also other figures by him of about one hundred species never figured before. The names and habitats of the insects were given, and the author pointed out the value of these scales for the assistance of the scientific entomologist in arranging genera and species; he then entered into the question of their probable use as air vessels in the economy of the insects possessing them.

The Chairman remarked that the scales of the Lepidoptera may prove to be as valuable in determining species as the scales of fishes.

Mr. Sidebotham alluded to the value of the binocular microscope in defining the cylindrical form of the plumules, and described the mode of finding them *in situ*, by breaking the wing.

Mr. Watson stated that some of Mr. Sidebotham's excellent drawings were taken under the eighth objective, magnifying 750 diameters. Mr. Watson further said that he had examined the wings of 400 specimens of the Papilionidæ, but had not discovered any plumules in that genera; he also alluded to several so called species from South America, of which no males have yet been found, others of which no females have yet been discovered, and suggested the possibility of some of these being male and female of the same species; to ascertain which, careful examination of the scales might be useful.

Mr. Watson exhibited a number of mounted specimens of the plumules, and four cases of the Lepidoptera from whose wings the 98 drawings figured by Mr. Sidebotham were taken. They were principally Pieris, Anthocaris, Thestias, Euterpe, and Eronia; amongst the former were some new and unnamed species from Celebes, with rare specimens from Venezuela, Quito, East and West Indies, Africa, and other parts of the world.

Mr. Dale placed on the table a number of washed soundings, of which several members took specimens for examination.

Mr. Dale also reported that the sulphate of copper and magnesia has been long known to be a compound salt. When the magnesian salt is in excess, it has seven equivalents of water; and when the copper salt is in excess, it has five equivalents of water. Mr. Dale has also made for the occasion samples of the double sulphate of copper and potash, the double sulphate of copper and ammonia, and the double chloride of copper and ammonia, which he distributed amongst the members. They were all beautiful polariscopic crystals, the chloride particularly so, and each has its characteristic form.

Mr. Linton exhibited the hairs on the Loasa Coccinea (Chili nettle), mounted by Mr. Heys.

Mr. Dancer exhibited a specimen of the Aulocadiscus formosus, which in consequence of a fracture since it was mounted, shows more distinctly the form of the projections that Mr. Sidebotham brought under the notice of the Section at the last meeting. These handle-shaped spines Mr. Dancer observed, when seen with the one-eighth power and binocular microscope, are found to project outwards from each of the four elevations on the surface of the valve.

Mr. Brothers exhibited the Floscularia ornata, and a fine group of Lacinularia socialis.

Mr. Mosley exhibited a specimen of Amœba, and described the peculiarity of its motion. He had observed one of them rise in a straight line four-fifths of its entire length, its internal particles appearing to force outwards a transparent or invisible integument; the point then fell over, forming an arch, after which it subsided into the common three or four-lobed form. In many specimens no vacuole was observed; in others, an apparent air or water space was noticed. A portion of the one under examination appeared to be blown outwards like a bladder, in which appeared a small animalcule making desperate efforts to escape. The best illumination for observing the internal motion, he considers to be Wenham's parabola and Lieberkühn, with a four-tenth objective.

NOTICES OF PATENTS.

769. *The Preparation of Hydrated Oxide of Iron, and the Application of such Prepared Oxide for the Absorption or Separation of Sulphur from Certain Gases.* J. G. Willans, Belfast. Dated March 27, 1861.

According to this invention the brown hæmatite, or other natural form of hydrated oxide of iron, is reduced to fine powder by grinding under mill-stones, the small particles are then separated from the coarser, either by sifting, or by means of currents of air, or water, when a material is obtained admirably adapted for absorbing the sulphuretted hydrogen from foul coal gas and other gaseous mixtures containing it. The second part of the invention relates to the treatment of sundry ferruginous products, such as roasted pyrites, forge cinder, hammer scale, and furnace slags, containing not less than 30 per cent. of iron, which are to be subjected to heat in contact with carbon, or any appropriate deoxidising agent, with the intention of producing a crude kind of metallic iron, and afterwards leaving this exposed to the rusting influence of air and moisture, to obtain a partially oxidised material well calculated to retain the sulphuretted impurities of common coal gas.

This proposal appears likely to be serviceably employed in the preparation of ochrey iron ore, and other forms of hydrated oxide which occur not only in Ireland, but away from coal, and hence comparatively valueless in some parts of England. A mixture of sulphate of iron, lime, and sawdust (really equivalent to hydrated oxide of iron), has formed the subject of more than one patent claim for a similar application. The ochrey ironstone of Oxfordshire has also been employed for the purification of gas.

775. *Brewing.* L. J. Vandecasteele, Lille, France. Dated March 28, 1861.

The improvements comprehended in the specification refer to the employment of lime in the mash tub, for the purpose of more thoroughly removing the suspended impurities from the wort. After clarifying in this manner, the excess of lime is precipitated from the beer by passing a current of carbonic acid gas, using for this purpose a perforated worm tube.

Ordinary beer holds in solution a large proportion of earthy phosphates, which would, no doubt, be partially removed by the addition of lime. It is a serious consideration whether perchance so dark coloured a beverage might

not sometimes disguise the presence of carbonate of lime particles, held in suspension in the beer, the administration of which to the human digestive system might be attended with dangerous consequences.

Grants of Provisional Protection for Six Months.

2750. William Bickford Smith, Camborne, and William Bennetts, Tuckingmill, Cornwall, "Improvements in the method of, and apparatus for, preventing the injurious effects occasioned by smoke, sulphur, and the deleterious gases which escape from stacks, chimneys, calcining houses, chemical and other furnaces."—Petitions recorded November 1, 1861.

2790. Frederick George Stuber, St. James's-road, Brixton, Surrey, "An improved hygrometer for measuring the humidity of the atmosphere, dampness of beds, garments, and for other similar purposes."—Petition recorded November 6, 1861.

2864. John Leslie, Esq., Conduit Street, Hanover Square, London, "Improvements in the manufacture of gas."—Petitions recorded November 13, 1861.

2900. George Parry, Ebbw Vale Ironworks, Monmouth, "Improvements in the manufacture of iron and steel."—Petitions recorded November 18, 1861.

Notices to Proceed.

1863. William Longmaid, Inver, Galway, Ireland, "Improvements in the manufacture of iron."—Petitions recorded July 24, 1861.

1869. Edward Haeffely, Kearsley, Lancashire, "Improvements in extracting copper from its ores."—Petition recorded July 25, 1861.

2001. Antoine Garzand, Boulevart St. Martin, Paris, "A new or improved apparatus for cutting up and reducing dye and other wood."—Petition recorded August 12, 1861.

2031. John Bethell, King William Street, London, "Improvements in the manufacture from steatite of journals, axle-boxes, and bearings for machinery, axles, and spindles to work in, smoking pipes, buttons, crucibles, and pots, for chemical and smelting purposes, and also of a lubricating compound for railway and other carriages."—Petition recorded August 15, 1861.

2618. Frederick John Evans, Gas Works, Horseferry Road, Westminster, "An improved mode of, and apparatus for, carburetting gases for the purpose of illumination."—Petition recorded October 19, 1861.

CORRESPONDENCE.

On the Chemico-Microscopical Characters of Beef and other Fatty Matters.

To the Editor of the CHEMICAL NEWS.

SIR,—Following out my experiments on fatty matters, as suggested in my paper contained in your last impression, I find that beef dripping treated with benzole, and then with ammonia, assumes under the microscope a similar character to that of butter, with this difference, that the crystals of beef fat are more strongly marked and of greater angular divergence, whilst the unerystallizable portions are more opaque than those of butter. There is a striking difference, however, in their solutions in ether by which any adulteration is clearly indicated. Beef fat depositing considerably after a time, but butter as before observed is entirely and permanently soluble at 65° and it is only at about 52° or 53° that anything falls when masses of beautiful velvetty crystals not unlike benzoic acid form; mutton dripping similarly treated is of a firmer and waxy like character, and under the microscope does not show any tendency to crystallization, being in the form of transparent layers or plates, and deposits from its ethereal solution in a closer and more granular form than beef dripping.

These are all the observations I have thought necessary to complete the subject. No doubt Anatomists and Physiologists will find the microscopic method I have suggested of some value in their researches.

The crystals I speak of are probably those of margarine, being when broken in plumose tufts or brushes, but when whole in the stellar form, the long needle points radiating from one common centre. They are smallish in cow fat, *i.e.*, butter, ox fat being, as before observed, similar but larger; mutton fat being nearly all stearin, while lard consists principally of olein and stearin, with comparatively very little margarine; hence its unctuosity and apparent indisposition to crystallise.

I am, &c., JOHN HORSLEY.

County Analyst's Laboratory, Police-Station, Cheltenham.

Chemical Nomenclature.

To the Editor of the CHEMICAL NEWS.

SIR,—Will you allow me to make a few observations in reply to Mr. McLeod's remarks on my new system of nomenclature?

Mr. McLeod objects to my system because of the complicated names to which it leads, though, at the same time, the longest of these is not a quarter the length of those he himself proposes.

None of the names which I have hitherto constructed from empirical formulæ are more than four syllables in length; the greater part are composed of two or three syllables,—so much for the charge of complexity.

I subjoin the names of a few bodies taken at random:—

Citric acid	$C_6H_8O_7'''$	kamlatic acid
Tannic acid	$C_{27}H_{22}O_{17}'''$	gremfetic acid
Benzoic acid	$C_7H_6O_2$	lakdatic acid
Salicylic acid	$C_7H_6O_3''$	lakfatic acid
Gallic acid	$C_7H_6O_5''$	lakhatic acid
Amygdalin	$C_{20}H_{27}NO_{11}$	chetranine
Harmaline	$C_{13}H_{14}N_2O$	tarbanamine
Harmine	$C_{13}H_{12}N_2O$	tasbanamine
Aconitine	$C_{30}H_{47}NO_7$	slohlanine
Morphine	$C_{17}H_{19}NO_3$	zehfanine

Mr. McLeod disposes of my system in a very summary manner. After having said that it was similar to those of Gmelin and others, he thinks that my name "for acetic acid (dagdatic acid) is not much simpler than Gmelin's term for alcohol (linavinam)," and he therefore condemns both.

By what peculiar process of oxidation or reduction Mr. McLeod was led to compare my name for acetic acid with Gmelin's for alcohol, I cannot for a moment conceive, and am equally at a loss to understand why, upon the ground of the one name not being much simpler than the other, he concludes that my system "has no chance of being adopted."

The names assigned by me to acetic acid, and ethylic alcohol, are dagdatic acid and dakbatic alcohol, both of which are as short and simple as those now in use, besides having the great advantage of expressing the formulæ of the bodies in question.

Gmelin furnishes names for all substances whatever; I restrict myself to what are commonly called organic bodies, for, as carbon, hydrogen, and oxygen appear to possess extraordinary faculties of entering into combination, the compounds of these elements require a special nomenclature of their own.

The systems of Gmelin, Laurent, and others, require long study before they can be comprehended, let alone made use of; mine, on the other hand, is very brief, easy to be understood, and can be at once turned to practical account, even if it be only as an aid to the memory.

Gmelin's names are lengthy, very unmusical, difficult to pronounce, and utterly unlike those at present employed, which, moreover, they were intended to supersede. Mine,

on the contrary, are short, possessed of considerable euphony, very like those at present employed, and may be either used in conjunction with these, or *per se*.

The plan of naming a body by enumerating all the radicals it contains, or is supposed to contain, must infallibly lead to names of great length; but, since this appears to be quite the fashion, it is a great pity that the names of these radicals do not give us the least idea of their composition.

The following are a few of the radicals named after my method:—

Methyl	CH_3	bafyl	
Ethyl	C_2H_5	dahyl	
Propyl	C_3H_7	falyl	
Butyl	C_4H_9	ganyl	
Amyl	C_5H_{11}	haryl	
Caproyl	C_6H_{13}	katyl	
	C_7H_{15}	lebyl	
	C_8H_{17}	mefyl	
	C_9H_{19}	nehyl	
Phenyl	C_6H_5	kahyl	
Ethylene	C_2H_4''	dagyl	
Glyceryl	C_3H_5'''	fahyl	
Acetyl	C_2H_3O	dafbayl	
Benzoyl	C_7H_5O	lahbayl	
&c.	&c.	&c.	

Are not these terms "short, concise, and expressive"? Mr. McLeod says that, "if a nomenclature that would not interfere with the designation of the derivatives of ammonia could be found, it would stand more chance of adoption." To this I answer that my system does not interfere with the method at present employed in naming these compounds, except so far as the radicals they contain are concerned; for instance, I call

Methyl-ethyl-amyl-phenyl-ammonium,
Bafyl-dahyl-haryl-kahyl-ammonium;

the only difference being that the names methyl, ethyl, &c., indicate nothing, whereas bafyl is CH_3, dahyl C_2H_5, haryl C_5H_{11}, and kahyl C_6H_5.

I have indeed employed certain syllables to indicate the amount of nitrogen in a substance when its nature was not thoroughly understood; thus, I have called morphine zehfanine, expressive of the formula $C_{17}H_{19}NO_3$; but, by and by, when the radicals which enter into the composition of this alkali are better known, we shall be able to construct a name for it five or six times as long as the preceding, and one which will therefore, no doubt, "stand more chance of adoption."

Empirical names may of course be framed for the compound ammonias, such as

Methylethylamylamine	$C_8H_{19}N$ mehnine,
Ethlamylaniline	$C_{13}H_{21}N$ telnine, and
Methylethylamylphenylammonium	$C_{14}H_{24}N$ vepnine.

But I do not advocate the use of such terms except under certain conditions, though I conceive that empirical names are at least as useful as empirical formulæ, and that all the arguments of Laurent and others in support of the one may be adduced with equal force in behalf of the other.

An "Inquirer" desires to know what name I give to albumen. My reply is that, when the formula of albumen is established beyond a doubt, it will be time enough to think of constructing a name expressive of its composition; but, whether a new appellation be devised or not, I would always retain the name of albumen, my desire being to preserve, as far as possible, names which are associated with the labours of illustrious men, which we have long been accustomed to pronounce, and which have become "familiar in our mouths as household words."—I am, &c.

John A. R. Newlands, F.C.S.

Chemical Notices from Foreign Sources.

I. GENERAL CHEMISTRY.

Compounds of Two Acids.—M. Schutzenberger announced some time ago, the formation of a compound of anhydrous sulphuric and anhydrous hypochlorous acids (Chemical News, vol. iii. p. 226). He has now (*Comptes-Rendus*, t. liii. p. 538) ascertained by analysis the exact proportions in which the acids had united. The compound is obtained by passing a current of hypochlorous acid over the anhydrous sulphuric. As soon as the two acids come in contact, the sulphuric liquefies, becomes hot, and takes a deep red colour. The product is thick, and on cooling soon solidifies to a mass of bright red acicular crystals very like chromic acid. These fuse about 55° C., and are immediately decomposed by water into hydrated sulphuric and hypochlorous acids. Organic matters such as sugar and alcohol, reduce the compound producing incandescence, iodine acts on it violently disengaging chlorine and forming iodic acid; in a word, it behaves as an energetic oxidizer. Heated quickly it detonates. By saturating it very carefully with pure potash, dividing the solution into two equal parts, estimating the chlorine in one and the sulphuric acid in the other, the author came to the conclusion that it was a compound of $4SO_3$ and ClO.

Hypochlorous acid gas passed into liquid sulphurous acid sets up a lively reaction; chlorine is evolved and there remains in the receiver a thick red liquid which contains both acids, but in what proportions the author has not yet determined.

Acetic and Arsenious Acids unite in equivalent proportions when boiled together. The product is a thick, colourless, syrupy body, which on cooling becomes vitreous and quickly attracts moisture. Water instantly decomposes it into the two acids. About 220° C. it evolves a good deal of carbonic acid and traces of arseniuretted hydrogen, hydrated acetic acid passing off at the same time and leaving a residue of metallic arsenic. The new compound is an acetate of arsenious acid: $C_4H_3O_3$, $As\,O_3$.

Acetic and Boracic Acids in the anhydrous state behave like the two former, but the solution takes place slower. The compound obtained is also a vitreous mass decomposable by water. By dry distillation the acetic acid is separated, and a reddish brown residue remains which contains all the boracic acid used. Like the above the compound of the two acids will no doubt have the formula $C_4H_3O_3$, $Bo\,O_3$.

Acetic and Tartaric Acids when boiled together form a thick, yellowish, syrupy liquid which begins to decompose at about 130° C, evolving a mixture of carbonic acid and carbonic oxide, the volume of the former a little exceeding that of the latter.

The same compound is formed by the action of chloride of acetyle on tartrate of lead, chloride of lead being also produced. This leads to the formula $C_8H_4O_{10}$, 2 ($C_4H_3O_3$).

Acetic and Sulphuric Acids. When anhydrous acetic acid is properly cooled it absorbs vapours of anhydrous sulphuric acid, forming a yellowish, gummy mess, which is soluble in water. The solution saturated with baryta water and separated by filtration from the sulphate of baryta, yields crystals having the characters and composition of sulphacetate of baryta. It follows that by the direct action of the two acids there is formed anhydrous sulphacetic acid, or the anhydrous bisulphate of the oxide of acetyle, $2\,SO_3$, $C_4H_3O_3$.

Action of Perchloride of Phosphorus on Several Elements.—M. E. Baudrimont has made a long series of experiments, from the results of which he draws the following general conclusions. (*Comptes-Rendus*, t. liii. p. 637.) 1. The metalloids exert a more varied action on perchloride of phosphorus than the metals. 2. Oxygen forming a chloroxide of phosphorus presents a remarkable case of the substitution of this gas for chlorine. 3. Sulphur and selenium do not act in the same way. Sulphur gives compounds of PCl_3 and S_2Cl. Selenium forms protochloride of phosphorus and protochloride of selenium, both free. Further, selenium does not form a chloroselenide of phosphorus, but a compound of PCl_5 with PCl_2 may be obtained. 4. Iodine acts on PCl_5 and forms ICl, which combines with the excess of PCl_5 to produce the compound PCl_5, ICl. 5. Metals, by simple mixture,

at a temperature short of volatilizing the PCl_5 form protochloride of phosphorus and metallic chlorides, which mostly unite with the excess of PCl_5 to produce double chlorides. This is the case with aluminium, iron, tin, bismuth, platinum, and perhaps zinc and copper. 6. When the metal is red hot, the "dechloruration" is more complete, and free phosphorus is obtained, which in some cases combines with an excess of the metal and forms metallic phosphides. 7. When the phosphorus becomes free it is always at the expense of the PCl_3 first formed and then decomposed. 8. Gold and platinum are acted on by perchloride of phosphorus, the latter metal most easily. 9. Of all metals antimony is the most easily acted on. 10. In all these reactions, the perchloride may be considered to act like strongly condensed chlorine, and the action seems to be greatly facilitated by the tendency which the PCl_5 has to unite with most of the chlorides to which it gives rise.

II. ORGANIC CHEMISTRY.

Compound of Aldehyde and Oxide of Ethylene.—Wurtz (*Comptes-Rendus*, t. liii. p. 378) formed a compound of the above by heating aldehyde and an excess of glycol together for eight days. The experiment was made with the view of ascertaining whether the two would combine to form bodies isomeric with the polyethylenic alcohols formed directly by the union of oxide of ethylene with glycol. The two did combine, but the author found a new compound having the formula $C_4H_8O_2$, showing the unexpected result that the aldehyde dehydrated the glycol and combined with the oxide of ethylene so produced. The new body is a colourless liquid, having an agreeable odour; the density at $0° = 1{\cdot}0002$; the boiling point 82° 5 C. It is soluble in 1½ times its volume of water, but chloride of calcium and potash separate it from the solution. Nitric acid acts on it violently, forming, among other products, glycolic and oxalic acids. It is not affected by caustic potash; at 100° C. it reduces partially and slowly an ammoniacal solution of nitrate of silver.

The author found that aldehyde and oxide of ethylene would not combine when heated together for several days. The aldehyde became resinified, and the oxide of ethylene remained unchanged.

The Formation of Oil in Olives.—M. S. de Luca has made an important series of observations on this subject (*Comptes-Rendus*, t. liii. p. 386). His object was to ascertain at what stage of the growth the fatty matter began to form, and what matter or matters preceded and gave birth to the oil. He found that a very young olive had the density 1·008, and that from this it slowly increased until the density reached 1·097. From this point, as the oil was formed, the density diminished, and the author found a perfectly ripe olive to have the specific gravity 1·007. Perhaps the most important point determined by the author was the presence of mannite, which, he says, appears to be essential to the formation of the fatty matter. The human physiologist may perhaps take a note of this fact. A peculiar bitter principle was also found in the green olives, which the author could not isolate. Like the mannite, it is also to be found in the leaves, which, perhaps in virtue thereof, appear to possess decided febrifuge properties.

Cinnamates and Nitro-cinnamates.—M. E. Kopp has prepared and described many of these (*Comptes-Rendus*, t. liii. p. 634). The general properties of the cinnamates he describes as follows:—Those with an alkaline base are soluble in water. The alkaline-earthy salts are but slightly soluble in the cold, but more so when heated. The earthy salts are insoluble, and are partially decomposed by boiling water. The metallic salts are almost insoluble even in boiling water, but are in general dissolved on the addition of a little acetic acid.

Nitro-cinnamic, though a weak acid, forms neutral salts, and decomposes alkaline carbonates. The alkaline salts are very soluble, the others are but slightly so, or are altogether insoluble. They all deflagrate when quickly heated.

Cinnamene, $C_{16}H_8$, is not only isomeric but completely identical with styrol. When pure it will change spontaneously into metacinnamene perfectly solid, transparent, and having all the properties, chemical and optical, of metastyrol.

III. ANALYTICAL CHEMISTRY.

Separation of Natural and Artificial Camphor.—We find the following in the *Archiv. für Pharmacie*, bd. clvi. s. 332. In an alcoholic solution of natural camphor ammonia gives but a slight precipitate which is redissolved on shaking the mixture. A similar solution of artificial camphor, under the like treatment, gives a flocculent precipitate which remains undissolved.

MISCELLANEOUS.

Royal Institution.—The following meetings will take place next week:—Thursday, December 26, at three o'clock, Professor Tyndall, "On Light" (juvenile lectures); Saturday, December 28, at three o'clock, Professor Tyndall, "On Light" (juvenile lectures).

An Appeal for the "American Journal of Science."—Professors Silliman and Dana, the proprietors and editors of the *American Journal of Science*, have issued the following appeal to their friends:—"Cut off by the exigencies of the times from a large number of our subscribers—residents in disloyal states, and participating in the inconveniences consequent on the general derangement of public affairs, the proprietors of this journal trust they may be permitted to express to their subscribers and to the friends of science generally the hope that they will in all cases renew and continue their subscriptions to the *American Journal of Science* for the ensuing year. Claiming the privilege of bearing cheerfully our share of the present demands on all patriotic citizens, our hope is to receive such a measure of co-operation from the friends of science as will enable us to sustain with credit the public trust so long, by their indulgence, committed to our hands. This co-operation we look for not only from those whose names have been long on our lists, but from many others also who may desire thus to testify their good-will to the cause we represent."

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

A Subcriber.—We will endeavour to ascertain.

C.R.—See Dr. Cattell's patent noticed in a previous number of the Chemical News.

Analyses of Yeast.—D. Clifton wishes to know where he can find Analyses of German dried yeast, and also Brewers' ale yeast.

O.—Noad's "Lectures on Electricity" is about as useful a book on the subject as can be placed in the hands of a person quite ignorant of the science.

M.D.—An electric light will have to be used, in order to throw metallic spectra on to a screen. The salts experimented upon must be placed in a small cavity bored out of the lower carbon pole, and the slit prism and lens must be arranged at such relative distances from each other and from the light, that a sharp image of the coloured bands is formed on the screen. This is not difficult to manage after a few trials, but it cannot be more fully explained without a diagram.

Iodide of Cadmium.—W. C.—The best way of preparing this salt is to take one part of cadmium in filings and two parts of pure iodine. Place them together in a capacious flask with a sufficient quantity of alcohol to cover them. Action will commence at once, attended with considerable evolution of heat. When the action ceases, heat the mixture till it is colourless. Filter from a few grains of cadmium, which will remain undissolved, evaporate, and crystallise.

THE CHEMICAL NEWS.

VOL. IV. No. 108.—December 28, 1861.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Relations existing between Atomic Weights, by M. J. S. STAS, *Member of the Royal Academy of Belgium.*

(*Continued from page* 325.)

Analysis of Chlorate of Potash.—The determination of the oxygen contained in chlorate of potash has been made so often that it might be asked if there was any utility in repeating it. What has led me to undertake this analysis is, that the concordant results of Berzelius, M. Pelouze, and M. de Marignac disagree with those of M. Maumené and of M. Penny, to the accuracy of which I can certify. To perform this determination I made use of two different methods which ought to yield errors in opposite directions. My object in acting thus was to ascertain the extreme limits between which the figure would be found. One of the methods consists in decomposing the chlorate by heat, so as to weigh the residuary chloride: this is the process employed successively by Berzelius, Pelouze, De Marignac, and Maumené. The other consists in decomposing the chlorate with hydrochloric acid, and then weighing the residuary chloride; this is the plan adopted by Penny, but which I have modified in its details.

The chlorate experimented upon was prepared by the means which I pointed out when speaking of chloride of potassium obtained from the chlorate. I need not now return to the subject. I will only say, that I am sure it contains neither iron, manganese, copper, chloride, nor alkaline sulphates. I am, however, certain that it contains traces of silica, which it has not been in my power to separate from the salt without decomposing it.

I will now explain the arrangement which I made to perform the operation by each of these two methods.

Determination of the Oxygen in Chlorate of Potash by Decomposing the Salt by Heat.—I have performed five experiments by this method: two in a hard glass globe, of about two litres capacity, furnished with a neck 55 or 60 centimètres long and 2 centimètres wide: and three in a sphere of hard glass, with two necks opposite to each other, analogous to the apparatus employed by M. Dumas in his syntheses of water.

In the experiments with the simple globe I curved the neck at right angles as close as possible to the reservoir. To the end of this neck I fastened, by means of a resinous cement, a metallic cap, on which a stop-cock screwed. The complete apparatus held a vacuum perfectly. In the weighings I used as a counterpoise a globe of absolutely the same capacity and weight as the one used in the experiment, placing, at the same time, on the two pans of the balance a weight superior to that which I had to determine. I thus performed the successive weighings by subtraction. I placed the same supplementary weight on each pan in order to remove any doubt about maintaining the quality of the arms of the balance during the successive weighings. The correction of the weight for the reduction to a vacuum was thus performed only upon the differences from the original weight,—differences which in this case corresponded to the weight of the substance.

When the equilibrium of the globe perfectly dry and devoid of air was established, and when, for fear of accident, I had even determined its absolute weight, I introduced in it the pulverised chlorate of potash, which I had heated in a current of pure and dry air to near its point of fusion. The neck of the globe having been cleaned to remove all traces of adhering chlorate, I plunged it into an oil-bath, heated to nearly 200°, and pumped the air out five or six times, passing into it each time pure and dry air, which had not been through the air-pump. After having brought the internal tension to exactly the same as it was at the first weighing, I brought it again into equilibrium by subtracting for this purpose weights from the pan to which the globe with the chlorate was attached. The globe being again filled with dry air, I unscrewed the stop-cock and filled the neck from its junction with the globe to within 10 centimètres of the cap fixed to its extremity with amianthus calcined with aqua regia. This amianthus I had transformed into a kind of felt, by stirring it up with water and then pouring the paste on to linen. Gases pass through this felt exactly as a liquid through a paper filter.

I then made a vacuum in the apparatus, heating the neck throughout nearly the whole of its length to carry off with the air the least traces of humidity which might have gained access during the introduction of the heated amianthus, and I determined the weight a third time, after having rarified the air to the same degree as in the two preceding weighings.

The apparatus being thus arranged, I placed the globe in a bath of magnesia, keeping its neck perfectly horizontal. To the stop-cock which terminated it, I adapted, by means of a caoutchouc connector, a hard, Bohemian glass tube, 60 centimètres long, by 1½ wide, drawn out at each end. The tube contained at each end a plug of felted amianthus, the remaining nine-tenths being filled with pure pulverulent silver precipitated by phosphorus. Before being placed in communication with the retort, it was carefully dried and weighed. This tube was followed by two others, curved U-shaped, filled with pumice-stone, moistened with sulphuric acid, likewise weighed; and finally, by a third U-tube, containing sulphuric pumice-stone, and intended to prevent the entrance of moist gas. The apparatus was terminated by a curved tube plunging to the depth of a millimètre only into water contained in a Woulf's bottle, which was furnished with a tube, curved, so as to allow of the connection with the disengaged oxygen.

As is well known, the decomposition of chlorate of potash demands excessive precautions to be effected

slowly; the slightest inadvertence destroys the experiment. But, on the other hand, when once understood and set going, the operation proceeds with extreme regularity. To effect the slow and regular decomposition of the chlorate, it is indispensable that the globe when in the bath should only rest upon the magnesia for five or six square centimètres of its surface. The rest of the under part of the globe must be at least one or two centimètres off as long as the chlorate is seen to be fused. When the chlorate has entirely passed to the state of perchlorate and chloride, the heated magnesia may be allowed to touch the globe gradually without fear of accident; but it is soon seen that, on account of the considerable radiating power of the magnesia, contact with this heated base is by no means necessary to effect the decomposition of the perchlorate.

When the disengagement of oxygen begins to slacken, I pile up the magnesia round the globe and elevate the temperature of the bath to nearly dull redness. I then cover the upper part of the globe with double wire gauze. I also surround the curved part of the neck and heat the gauze to dull redness by means of glowing charcoal placed around it.

At other times in arranging the apparatus I have surrounded the neck of the globe from the curvature to 15 centimètres from the cap in an iron case filled with magnesia. When the operation is completed, I heat this case likewise to redness. In this way the chlorate and the perchlorate carried mechanically to the upper part of the globe, and retained by the amianthus in the neck, decompose and leave chloride.

At the same time that I heat the bath of magnesia to determine the decomposition of the chlorate, I heat to dull redness the tube containing the finely divided silver precipitated by phosphorus. This tube was placed in an iron case filled with magnesia, so as to completely cover it. It was kept at dull redness as long as the disengagement of oxygen lasted. The object of this tube was to arrest the traces of chlorine which almost always accompany the oxygen evolved upon the calcination of chlorate of potash.

After having traversed the apparatus, the oxygen was evolved perfectly transparent during the whole of the operation. However, in spite of the precaution which I took to decompose the chlorate with extreme slowness, and to place in the path of the oxygen a long tube containing finely divided silver, I think the traces of chlorine have still been carried away unfixed by the metal. In any case, however, the oxygen on its issue from the globe could only retain excessively minute traces of chlorine, since the greater part fixed by the silver did not amount to more than a three-thousandth part of the weight of the oxygen.

In the experiments the desiccation of the chlorate of potash and of the apparatus was so completely effected that the U tubes with sulphuric pumice stone never augmented in weight more than 0·004 gramme.

The globe being cooled, I again exhausted the air and weighed it.

The determination by this means of the oxygen in chlorate of potash requires, therefore, four successive weighings:—

I. The globe exhausted of air.

II. The globe with the chlorate exhausted of air.

III. The globe with the chlorate and the neck filled with amianthus to retain the chlorate and perchlorate, exhausted of air.

IV. The globe with the chloride and exhausted of air.

With the view of reducing these four weighings to three, I replaced the one necked globe with another having two necks on opposite sides. To the extremity of each I fastened metallic caps by means of a slightly fusible resinous cement. One of these caps was furnished with a stop-cock; the other was closed with a solid piece screwed into it. The neck furnished with the cap carrying the stop-cock was three-quarters filled with felted amianthus. The globe having been dried at a high temperature by passing a current of air through it, I weighed it. Through the opposite opening I then introduced the chlorate of potash dry and warm. After having caused a current of dry air to pass for several hours through the globe at a temperature of about 200°, I made a vacuum in it, and weighed it a second time when it was quite cold. Then I connected the globe with the system previously described, and proceeded to the decomposition of the chlorate as explained above, but with sufficient slowness to cause the operation to last from eight in the morning till nine in the evening. The disengagement of oxygen having ceased, I decomposed by the means above mentioned all the perchlorate and the chlorate deposited at the upper part of the globe, and retained by the amianthus in the neck.

After cooling I exhausted the air from the globe, and weighed it.

It will with difficulty be imagined that glass vessels can preserve their weight intact when they are heated for so long a time. The perfect concordance of my results with those of Berzelius, M. Pelouze, and M. de Marignac should satisfy all on this point. However, to show to what degree one can rely upon the preservation of the weight of vessels of considerable volume heated in magnesia, I give below the result of the

Analysis of Chlorate of Potash.

First Series.

Quantity of Oxygen disengaged from the Chlorate by the action of heat.

Numerical Order.	Apparent Weight of the Chlorate.	Weight of the Chlorate reduced to a vacuum.	Apparent Weight of the Evolved Oxygen.	Weight of the Oxygen reduced to a vacuum.	Weight of the Chlorine fixed by the Silver.	Weight of the Oxygen corresponding to the Chlorine fixed.	Corrected Weight of the Oxygen.	Oxygen evolved from 100·000 parts of Chlorate.	Chloride of Potassium produced from 100·000 parts of Chlorate.
	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.	grammes.		
I.	69·8835	69·8730	27·3735	27·3694	0·0075	0·0068	27·3636	39·1620	60·8380
II.	82·1385	82·1260	32·1745	32·1697	0·0110	0·0085	32·1612	39·1605	60·8395
III.	86·5140	86·5010	33·8775	33·8725	0·0025	0·0020	32·8705	39·1560	60·8440
IV.	132·9430	132·9230	52·0570	52·0492	0·0085	0·0060	52·0430	39·1527	60·8473
V.	127·2315	127·2125	49·8205	49·8130	0·0036	0·0028	49·8102	39·1550	60·8450
							Mean.	39·1572	60·8428

experiments which I have made with the identical globes used in experiment No. I. and in experiments Nos. III., IV., and V.

No. I.

1. Weight of the globe of 1·729 litres capacity exhausted of air to 0·003 millimètres . 823·917
2. Weight of the globe after having been heated for six hours in a bath of magnesia to the point of rendering the lower part milky,—
   a. After cooling for three hours . . 823·913
   b. After eight hours . . . . 823·917
   c. The next day . . . . . 823·9175

Nos. III., IV., and V.

1. Weight of the globe exhausted to 0·0032 millimètres . . . . . 1736·409
2. Weight of the globe heated to redness in magnesia, after cooling for eight hours . 1736·410
3. Weight of the globe heated in magnesia from eight in the morning till four in the afternoon. The bottom was completely milky. Exhausted to 0·003 millimètres. After five hours' cooling . . . . 1736·408
4. Weight of the globe the next day . . 1736·409

I have employed for the analysis of chlorate of potash three specimens of the salt from different sources, but purified by the same process. One specimen served for experiment No. I., another for Nos. II. III., and a third for Nos. IV. and V.

(To be continued.)

On the Specific Gravity of Substances in the Liquid and Solid State, by O. Richter, *Ph.D.*

I beg leave to draw the attention of chemists to the singular fact, that, whereas in our handbooks and periodicals the various chemical and physical properties of substances are duly recorded, comparatively little is said about their specific gravity in the liquid and solid state. In most cases nothing at all is said about it, or we must content ourselves with a vague statement that the body is lighter or heavier than water, &c. Considering, however, that a correct and thorough knowledge of this property of matter is of paramount importance, both in a theoretical and in a practical point of view, I think that the simple mention of this fact will convince the chemical public of the necessity of at once setting to work in order to complete this portion of our science. Confining myself to the theoretical point of view, I shall observe, in the first place, that a knowledge of the atomic volume, which is obtained by dividing the atomic weight by the specific gravity, may lead to an insight into the nature and *modus operandi* of that mysterious cause which determines and modifies it. This volume is evidently the result of the combined repulsive energies proper to the various elements which are grouped together in the constituent molecule. Now, it is natural to suppose that every chemical element, in addition to its weight-equivalent, possesses also a volume-equivalent, with which it enters into combination, so that, supposing this latter to be as constant as the former, the atomic volume of chemical compounds would always be equal to the sum of the atomic volumes of their component elements. Experiment, however, teaches us that the cases which favour this hypothesis are comparatively of rare occurrence. Hence, in order to reconcile and explain the anomalies, we are obliged to suppose a certain rate of increase or decrease in the atomic volume of one or more or all the constituents. The speculations of Kopp, Schroeder, Playfair, and others in this direction, made with the view of discovering the fundamental law of variation, to which the atomic volumes of all the elements are held to be subject, have as yet led to no satisfactory result. The inquiry was almost exclusively confined to inorganic chemistry; and here the number of ascertained cases was far too limited to arrive at valuable and extensive generalizations, while the organic part presented even more scanty material for the solution of this all-important problem.

The remarkable discoveries of Playfair relative to the atomic volume occupied by the acid and basic constituents of salts, and by these latter according as they are either anhydrous or associated with a larger or smaller amount of water of crystallisation, appear to conceal within them a profound philosophical truth, viz. that the eighth part of the volume of ice, which Playfair calls the unit volume, is really the standard whereby all the volume equivalents of the various chemical elements will one day be correctly measured and calculated. And here I may express the hope that this highly gifted philosopher, who is so intimately familiar with all the difficulties of this species of research, may still persevere in his efforts to penetrate the secret of the wonderful mechanism which controls and accomplishes all those endless variations in the atomic volume of chemical substances, and, what is very remarkable, which causes these variations to be superinduced upon the molecule without the slightest derangement taking place in the relative positions of its constituents. Hence, on the hypothesis that the chemical elements consist, not of single atoms, but of a definite number of such atoms associated according to some fixed principle of grouping, all the modifications in the physical properties of matter which we are in the habit of distinguishing by the terms allotropism, polymorphism, fusing and boiling points, crystalline form, optical and electro-magnetic polarity, &c., ought to be considered as so many functions of one and the same variable magnitude—namely, the atomic volume.

This view of the genetic relations between atomic volume and physical properties appears also to be fully borne out by experiment, for we invariably find that a change in the former involves generally a corresponding change in the latter, and *vice versa*; and, moreover, in thus modifying the physical conditions under which the chemical affinities are called into action, it is reasonable to expect likewise a corresponding change in the range and intensity of these latter. Accordingly, it is easy to see why sulphur and phosphorus, and, indeed, many other elements, if not the whole of them, if presented in one of their allotropic states, will be readily attacked by oxygen, while in another they remain passive towards that re-agent, at least up to a certain temperature.

I shall now, in the second place, take this opportunity in stating, that, for the last twelve years, I have devoted much time and labour in composing a catalogue of the densities and atomic volumes in the liquid and solid state of as many chemical substances as I could gather together from the various compendiums and journals within my reach. This catalogue contains, in round numbers, 600 inorganic and 350 organic substances, the sum of which amounts to what comes evidently to be a mere fraction in comparison with the hundreds of thousands of chemical productions, which, however carefully they may have been investigated in other respects, have yet been entirely neglected with regard to their densities in the liquid and solid state. The publication of

this catalogue, which, even in its present imperfect form, furnishes abundance of material for speculation, has only been delayed in the hope that chemists would soon make an united and vigorous effort in this direction.

With reference to this subject, I request the analysts to bear in mind that, when there exists a striking difference in the densities of a body as stated by different observers, it may in general be assumed that they have indeed examined one and the same substance, but which is the same in a chemical point of view only, and altogether different in a physical point of view. But even in such cases as the family of the sulphurs, or that of the oils of turpentine, where the differences in density are comparatively small, experiment clearly shows that, by varying their atomic volume, these substances have at the same time experienced certain changes in their physical properties, and which are sufficiently marked to individualise them as members of the same family. In the preceding remarks I have endeavoured to prove that chemistry has for its foundation not a simple, but a complex principle.

On the one hand, it is the purely chemical principle, whatever its nature may be, which determines the various forms of molecular arrangement, and it is the ponderable portion alone of the various kinds of atoms which in their constant weight-equivalents furnishes the basis of calculation. On the other hand, it is the purely physical principle, whatever its nature may be, which determines the atomic volume of the molecules, and it is the imponderable portion alone of the various kinds of atoms which in their variable volume-equivalents furnish the basis of calculation.

Accordingly, our tree of chemical knowledge splits up into two main branches, for which I would propose the terms Pondo-Chemistry and Impondo-Chemistry. If this division be correct, it follows that, in order to unravel the mixed and complex character of the phenomena, our present methods of analysis, however well adapted they may be for that branch which is engrafted upon the chemical principle, will require to be modified so as to become available for the other branch also.

CORRESPONDENCE.

Chemical Nomenclature.

To the Editor of the Chemical News.

Sir,—As special attention has lately been drawn to the subject of Chemical Nomenclature, perhaps a few additional remarks thereupon might not be out of place in your valuable journal.

I think it is sufficiently obvious that many of those who have offered us a new terminology expect more from words than they are lawfully capable of expressing. It is too much to suppose that a single word shall denote the constitution of a body, the number of atoms it contains of certain elements, and the names of the elements themselves. Your correspondent "Inquirer" (in No. 106) appears to have perceived this; and humorously asks of one propounder by what name Albumen is recognised in his system. I, for my part, am considerably at a loss to see what is to be gained by the employment of this "concentrated essence" of language; and it would be more difficult, perhaps, for the memory to retain the all-comprehensive name than the facts and theories vainly sought to be included under it.

The purely arithmetical systems hitherto proposed abound, to excess, with the most unmusical and distasteful names,—names which will never be adopted as components of a great and useful arrangement, any more than, to take a well-known instance, the Latin verses constructed from tables can be combined to a poem. From such systems, too, the Natural History element is too much excluded; so that it would be hardly an unwarrantable presumption to anticipate for them the fate which, in Botany, has attended the classification of Linnæus.

So extensive a scheme of innovation as must be necessarily contemplated by any one who wishes to revolutionize an extensive nomenclature is one only suited for veteran practitioners. And, even from them, how slowly have alterations been adopted! The well-matured and excellent views of Gerhardt have been a considerable number of years meeting with their present success, and that is by no means complete. What, then, shall be said of some claims which have been recently advanced?

On the whole, therefore, I would venture to recommend that the steps which are taken to alter our nomenclature should be as gradual as possible, inasmuch as small changes are always discussed more soundly and adopted with greater security. This proceeding would also be incalculably more just to inventors, whose proposals could thus be examined with brevity and ease.

I have submitted these remarks in the hope, on the one hand, of moderating over-hasty theoretical zeal, and, on the other, of perhaps furnishing one or two tests for the stability of proffered systems. Without adopting some such considerations as these, we shall have our terminology laid open to the just though unwelcome charge, "Tot chemici, tot theoriæ."—I am, &c.

Edmund J. Mills.

Analysis of Yeast.

To the Editor of the Chemical News.

Sir, — In reference to your correspondent's (Mr. D. Clifton) enquiry about analysis of yeast, allow me to communicate briefly the following:—There are analyses of brewer's yeast quoted in Schubarth's well-known work, *Handbuch der technischen Chemie und Chemischen Technologie*, Vol. iii. Berlin: 1851. On page 506 we read. According to Schlossberger and Wagner, brewer's yeast, deduction being made of the ashes, is composed as follows:—

	Schlossberger.		Wagner.	
	Oberhefe.[1]	Unterhefe.[2]	Oberhefe.	Unterhefe.
Carbon	50·05	48·03	44·372	49·761
Hydrogen	6·52	6·25	6·040	6·804
Nitrogen	11·84	9·80	9·203	9·171
Oxygen	31·59	35·92	40·385	34·264

Beside this a most elaborate paper has been published in 1845, by Professor G. J. Mulder, at Utrecht in his *Scheikundige Onderhoekinzer*, Vol. ii., pp. 409 to 482, this paper contains, Mulder's researches on the so-called German dried yeast, in reality a product obtained in very large quantities from the distilleries at Schiedam, Holland; that yeast is composed of a cellular tissue $C_{12}H_{10}O_{10}$, and of a proteine compound $15(C_{40}H_{62}N_{10}O_{12}) + S$. The ash in the anhydrous dried yeast amounts to 10 per cent. and contains phosphoric acid, phosphate of lime, and other saline matter usually met with in substances of vegetable origin. The cellular tissue amounts to from 30 to 45 per cent. and the proteine compound from 55 to 70 per cent. Yeast contains moreover a very small amount of margaric and elaic acids. In Mulder's works on Wine, and that on Beer, valuable information is given about fermentation and yeast. I could quote several other sources which will give information on this subject, but think this may satisfy your correspondent. I am, &c.

Dr. A. Adriani, F.R.N.I.E., &c.

Laboratory, Edinburgh, December 23.

[1] Yeast from upper, or surface fermentation.
[2] Yeast from under fermentation.

On Butter and Other Fats.

To the Editor of the Chemical News.

Sir,—When I first put forward my original paper, as well as the subsequent ones, on Butter, I felt so convinced of the accuracy of my statements that I had no idea they would have elicited so much discussion.

In his conclusion No. 1, Dr. Ballard has set out with an erroneous quantity, and would appear to make out that butter is not entirely soluble in ether at 65°. Of course, if a person uses an immoderate quantity, which I contend he has, what otherwise could be expected?

Since reading Dr. Ballard's last paper, I have made the following experiments, which go far to make good all I have previously asserted:—

Experiment 1.—Ten grains of pure butter, on being dissolved in one drachm of ether, by agitation of the phial in the warm hand for a minute or so, and kept at a temperature of 65° for twelve or more hours, remained permanent; indeed, that which I made two months ago, when I first wrote my paper, has scarcely deposited, and that little is due to cold.

Experiment 2.—Twenty grains, similarly treated, dissolved at first, but did not continue permanent longer than an hour or so, owing to an insufficiency of ether.

Experiment 3.—Ten grains each of butter and beef dripping, dissolved in one drachm of ether, and the bottle held in the hand for a minute or so, the beef fat, from being softer than the butter, dissolved soonest; but when both were dissolved and kept at a temperature of 65° the beef fat deposited to a certain extent, and at 55° the deposit of beef fat occupied full half the bottle. By this we can readily detect beef fat in butter, the deposit being scaliform to the eye, but is in reality a mass of margarine crystals, and which did not re-dissolve in a room heated to 65°.

Experiment 4.—Twenty grains of beef fat, similarly treated, deposited considerably on standing, and at 55° to more than half the bottle full.

Experiment 5.—Ten grains each of butter and lard, similarly treated, although held in the hand for a long time, could not well be dissolved, but remained suspended just like a soap of hartshorn and oil, occupying full four-fifths of the bottle at 65°.

Experiment 6.—Ten grains of mutton dripping, similarly treated, at 65°, with one drachm of ether, deposited to the extent of three-fourths of the bottle full.

Hence, we come to the practical conclusion that the stearin of both lard and mutton dripping is nearly, if not quite, insoluble in ether at 65°, which establishes the point I originally founded my paper upon, and that Dr. Ballard, who evidently means well, is greatly mistaken in supposing that butter renders lard more soluble, according to his conclusion No. 7, as proved by my experiment No. 5.

The above simple set of miniature experiments shows unmistakeably, notwithstanding all that has been advanced against it, that the ether test is preeminently worthy of confidence in every respect; in short, combined with the microscopic method I have since published, comprises all that is required in the investigation of fatty bodies generally.—I am, &c. John Horsley, F.C.S.

County Analyst's Laboratory, Police Station, Cheltenham.

MISCELLANEOUS.

The approaching Eclipse of the Sun.—At the last meeting of the Manchester Literary and Philosophical Society, Mr. Dickinson read a "Note on the Eclipse of the Sun, December 31, 1861." This eclipse, being small compared with several that have lately occurred, will not attract so large an amount of general attention; it will, however, be of considerable interest to scientific persons, and in the hope that the members of this Society will not consider it an unimportant phenomenon, the following results are submitted to enable them to compare their observations with the computed times. Calculations for Manchester (Royal Infirmary), lat. N. 53° 29′, long. W. 2° 14′.

	H.	M.	S.
Eclipse begins, December 31 .	1	49	19
Greatest Phase . . .	2	49	9
Eclipse ends	3	45	29

mean time at Greenwich. Magnitude of the Eclipse (Sun's diameter = 1) 0·413 on the Sun's southern limb. Angle from North Pole, of first contact, 143° towards the West; last contact, 108° towards the East. Angle from vertex, of first contact, 157° towards the West; last contact, 80° towards the East, for direct image.

Long Tube Barometer.—After a recent meeting of the Institute of Civil Engineers, Mr. R. Howson exhibited in the library a Barometer, consisting of a long tube freely suspended open end downwards, a cistern which was of a tubular shape, and a "stalk." The stalk was a glass tube, sealed at both ends, attached firmly at its lower end to the bottom of the cistern, and rising axially up the tube until it nearly reached the surface of the mercurial column. The consequence of this arrangement was, that the top of the stalk came into the region of very low pressure, and there was an excess of pressure tending to force the cistern upwards. This excess was represented by the weight of the cistern (and stalk), and the contained mercury, so that under a given atmospheric pressure, the cistern would always hang suspended at a given level. When the pressure of the atmosphere rose, a portion of mercury left the cistern and passed into the tube, and the cistern alone arose, until the level was replaced by the immersion of the glass which formed the tube. When the pressure fell, the converse took place, an elongated scale was thus produced, the extent of range being dependent upon the relative areas of the tube, and of the glass which composed it. The action might also be simply viewed as that of a long piston, or plunger, with a liquid packing, having a vacuum on its upper side, and a self-graduating weight attached to its lower side.—*Mechanics' Magazine.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor; and *Advertisements* and *Business Communications* to the Publisher at the Office, 1, Wine Office Court, Fleet Street, London, E.C.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Magenta.—The correct way is by distillation. Different naphthas may be compared by ascertaining what per-centage comes over below 212°. The more the better. Benzine and benzol are the same thing. The quality of nitrobenzol can be readily ascertained by the smell, it should be very delicate and pure, and should leave no unpleasant odour when a drop is evaporated on the hand.

G. H. F.—Your question is exceedingly elementary. Sulphide of calcium is composed of one equivalent of sulphur and one of calcium, the metallic basis of lime. Sulphate of lime, on the contrary, consists of one equivalent of lime and one equivalent of sulphuric acid. The former has the formula CaS, and the latter, CaO.SO$_3$. They are totally distinct bodies, and have no resemblance to each other in their properties.

J. Shields.—A letter addressed to M. Kopp, at the Chemical Society of Paris, would find him.

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